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THE RACIAL GEOGRAPHY OF EUROPE.

A SOCIOLOGICAL STUDY.

(*Lowell Institute Lectures, 1896.*)

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VI.—FRANCE—THE TEUTON AND THE CELT.

SEVERAL reasons combine to make France the most interesting country of Europe from the anthropological point of view. More is known of it in detail than of any other part of the continent save Italy. Its surface presents the greatest diversity of climate, soil, and fertility. Its population, consequently, is exposed to the most varied influences of environment. It alone among the other countries of central Europe is neither cis- nor trans-alpine. It is open to invasion from all sides alike. Lying on the extreme west coast of Europe, it is a place of last resort for all the westward-driven peoples of the Old World. All these causes combine to render its population the most heterogeneous to be found on the continent. It comprises all three of the great ethnic types described in our last paper, while most countries are content with two. Nay more, it still includes a goodly living representation of a prehistoric race which has disappeared almost everywhere else in Europe.*

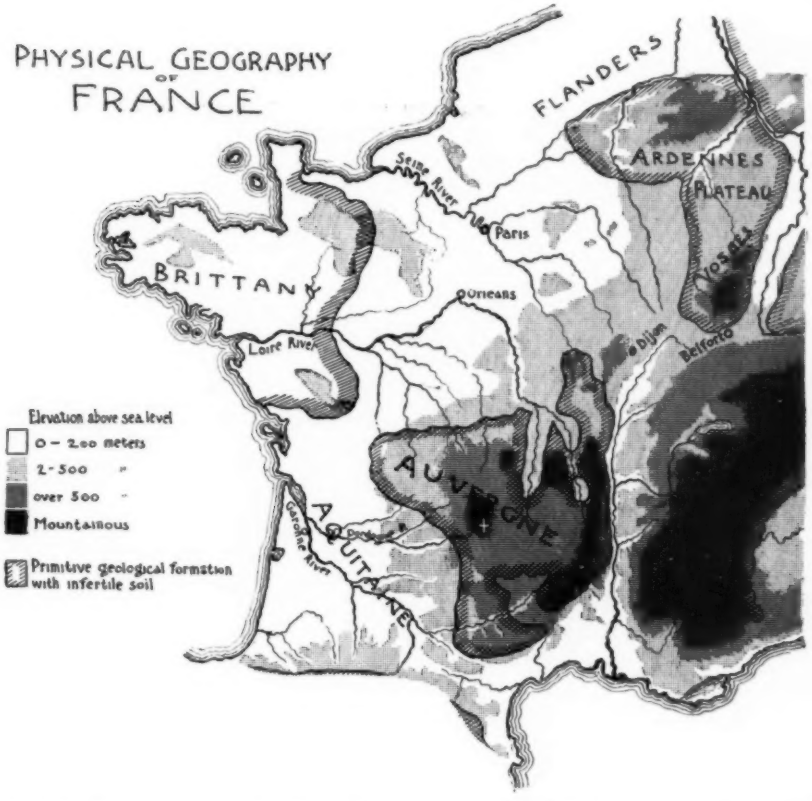
* It would be ungracious not to acknowledge publicly my indebtedness to two of the foremost authorities upon the population of France—Dr. R. Collignon, of the École Supérieure de Guerre at Paris, and Prof. G. V. de Lapouge, of the University of Rennes in Brittany. Invaluable assistance in the preparation of this and the following paper has been rendered by each. No request, even the most exacting, has failed of a generous response at their hands.—W. Z. R.

Thirty years ago lay observers began to note differences in central France between the people of the mountains and of the plains. As early as 1868 Durand de Gros noted that in Aveyron, one of the southern departments lying along the border of a mountainous area, the populations of the region thereabout were strongly differentiated. On the calcareous plains the people were taller, of light complexion, with blue or blue-grayish eyes and having fine teeth. In the upland areas, of a granitic formation, the people were stunted, dark in complexion, with very poor teeth. These groups used distinct dialects. The peasants differed in temperament. One was as lively as the other was morose. One was progressive, the other was backward in culture, suspicious of innovations. This same observer noted that the cattle of the two regions were unlike. On the infertile soils they were smaller and leaner, differing in bodily proportions as well. He naturally, therefore, offered the same explanation for the differences of both men and cattle—namely, that they were due to the influences of environment. He asserted that the geology of the districts had affected the quality of the food and its quantity at the same time, thereby affecting both animal and human life. When this theory was advanced, even the fact that such differences existed was scouted as impossible, to say nothing of the explanation of them. As late as 1889 I found a German geologist, in ignorance of the modern advance of anthropology, strongly impressed by these same contrasts of population, and likewise ascribing them to the direct influence of environment as did the earlier discoverer. These differences, then, surely exist even to the unpracticed eye. We must account for them; but we do it in another way. The various types of population are an outcome of their physical environment. This has, however, worked not directly but in a roundabout way. It has set in motion a species of social or racial selection, now operative over most of Europe. This process it is our province to describe in this paper.

Before we proceed to study the French people, we must cast an eye over the geographical features of the country. These are depicted in the accompanying map, in which the deeper tints show the location of the regions of elevation above the sea level. At the same time the cross-hatched lines mark the areas within which the physical environment is unpropitious, at least as far as agriculture—the mainstay of economic life until recent times—is concerned.

A glance is sufficient to convince us that France is not everywhere a garden. Two north and south axes of fertility divide it into three or four areas of isolation. These differ in degree in a way which illustrates the action of social forces with great clearness. Within these two axes of fertility lie two thirds of all the

cities of France with a population of fifty thousand or over. The major one extends from Flanders at the north to Bordeaux in the southwest. Shaped like an hourglass, it is broadened about Paris and in Aquitaine, being pinched at the waist between Auvergne and Brittany. The seventy-five miles of open country which lie between Paris and Orleans have rightly been termed by Kohl "the Mesopotamia of France." This district is not only surpassingly fertile; it is the strategic center of the country as well. At this point the elbow of the Loire comes nearest to the Seine



in all its course. An invader possessed of this vantage ground would have nearly all of France that was worth having at his feet. If the Huns under Attila, coming from the east in 451, had captured Orleans as Clovis did with his Frankish host at a later time, the whole southwest of France would have been laid open to them. The Saracens, approaching from the opposite direction along this axis, had they been victorious at Tours, could in the same way have swarmed over all the north and the east, and the upper Rhone Valley would have been within reach. The Normans in their turn, coming from the north-

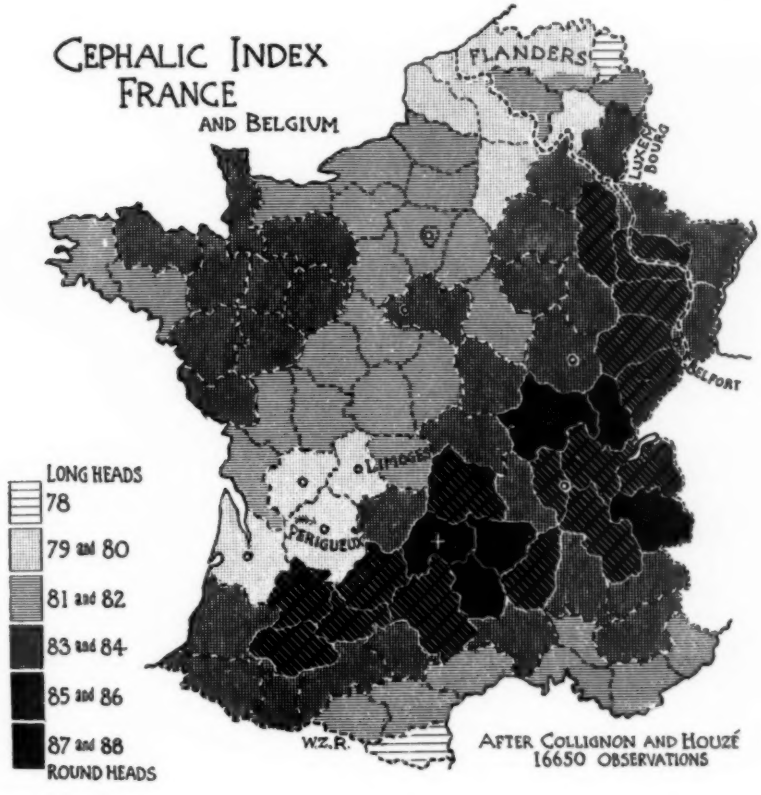
west, must needs take Orleans before they could enter the heart of the country. Finally, it was for the same reason that the English fought for the same city in 1429, and the Germans took it twice, in 1815 and again in 1870. This district, then, between Paris and Orleans, is the key to the geographical situation, because it lies at the middle point of this backbone of fertility from north to south.

The second axis, lying along the river Rhone, is of somewhat less importance as a center of population because of its extreme narrowness. Yet it is a highway of migration between the north and the south of Europe, skirting the Alps; and it is easily accessible to the people of the Seine basin by the low plateau of Langres near the city of Dijon. This renders it the main artery of communication from Paris to the Mediterranean. Down its course Teutonic blood has flowed. The culture of the south has spread into northern Europe in the contrary direction. Such is the normal exchange between the two climates in human history, the world over. The great fertility of the Rhone axis, moreover, is in strong contrast to the character of the country upon either side. Judged by its population, it merits the important position we have here assigned to it.

These two axes of fertility divide France, as we have said, into three areas which exhibit the phenomena of social isolation in different degrees. East of the Rhone lies Savoy, exceedingly mountainous, with a rigorous Alpine climate, and of a geological formation yielding with difficulty to cultivation. This region combines two safeguards against ethnic invasion. In the first place, it is not economically attractive; for the colonist is unmoved by those charms which appeal to the tourist to-day. We reiterate, the movement of peoples is dependent upon the immediate prosperity of the country for them. It matters not whether the invading hosts be colonists, coming for permanent settlement, or barbarians in search of booty; the result is the same in either case. Savoy, therefore, has seldom attracted the foreigner. It could not offer him a livelihood if he came. In the second place, whenever threatened with invasion, the defense of the country was easy. Permanent conquest is impossible in so mountainous a district. Combining both of these safeguards in an extreme degree, Savoy, therefore, offers some of the most remarkable examples of social individuality in all France.

The second area of isolation lies between our two north and south axes of fertility—that is to say, between the Rhone on the east and the Garonne on the southwest. It centers in the ancient province of Auvergne, known geographically as the *Massif Centrale*. This comprises only a little less than two thirds of France south of Dijon. In reality it is an outpost of the Alps cut off

from Savoy by the narrow strip of the Rhone Valley. Much of it is a plateau elevated above two thousand feet, rising into mountains which touch three thousand feet in altitude. Its climate is unpropitious; its soil is sterile; impossible for the vine, and in general even for wheat. Rye or barley alone can be here successfully raised. At the present time this region is almost entirely given over to grazing. It has vast possibilities for the extractive arts; but those meant nothing until the present century. For all these reasons Auvergne presents a second degree



of isolation. It lacks all economic attractiveness; but it is not rugged enough in general to be inaccessible or completely defensible as is Savoy.

Brittany, or Armorica, the third area of isolation, is perhaps somewhat less unattractive economically than Auvergne. It is certainly less rugged. Extending in as far as the cities of Angiers and Alençon, it is saved from the extreme infertility of its primitive rock formation by the moisture of its climate. Neither volcanic, as are many parts of Auvergne, nor elevated—seldom rising above fourteen hundred feet—it corresponds to our own

TEUTONIC TYPE. Blond. Index, 77.

New England. For the farmer, it is more suited to the cultivation of religious propensities than to products of a more material kind. It is the least capable of defense of the three areas of isolation; but it redeems its reputation by its peninsular position. It is off the main line. It is its remoteness from the pathways of invasion by land which has been its ethnic salvation.

ALPINE TYPE. Hautes Alpes. Neutral. Index, 96.

In order to show the effect which this varied environment, above described, has exerted upon the racial character of the French people, we have arranged a series of three parallel maps in the following pages, showing the exact distribution of the main physical traits. For purposes of comparison certain cities are located upon them all alike, including even the map of physical geography as well. A cross in the core of Auvergne in each case; the Rhine shown in the northeast; the location of Paris, Lyons, Belfort, etc., will enable the reader to keep them all in line at once.

Earlier in our work we have seen that the several physical traits which betoken race vary considerably in their power of resistance to environmental influences. This resistant power is greatest in the head form; less so in the pigmentation and stature. As we are now studying races, let us turn to our most competent witness first. It will be remembered, from a preceding paper, that we measure the proportions of

MEDITERRANEAN TYPE. Brunette. Index, 76.

the head by expressing the breadth in percentage of the length from front to back.* This is known as the cephalic index. We have also seen that a high index—that is, a broad head—is the most permanent characteristic of the so-called Alpine race of central Europe. This type is bounded on the north by the long-headed and blond Teutons, on the south by a similarly long-headed Mediterranean stock, which is, however, markedly brunette. It is with these three racial types that we have mainly to do in this paper. Passing over all technicalities, our map of cephalic index shows the location of the Alpine racial type by its darker tints; while, in proportion as the shades become lighter, the prevalency of long and narrow heads increases.

The significance of these differences in head form to the eye is manifested by the three portraits at hand. The northern long-headed blond type, with its oval face and narrow chin, is not unlike the Mediterranean one in respect of its cranial conformation. This particular Teutonic type is slightly misleading, from the mode of dressing the hair, which tends to exaggerate the width at the forehead. The Alpine populations of central France are exemplified by rather an extreme type in our portrait, in which the head is almost globular, while the face is correspondingly round. Such extremes are rare. They indicate the tendency, however, with great distinctness. The contrast between the middle type and either extreme is well marked. Even with differences but half as great as those between our portrait types, it is no wonder that Durand and other early observers should have insisted that they were real and not the product of imagination. They may have erred in their explanations, although not in their facts.

Recalling the physical geography of the country, as we have described it, the most patent feature of our map of cephalic index is a continuous belt of long-headedness, which extends from Flanders to Bordeaux on the southwest. It covers what we have termed the main axis of fertility of France. A second strip of long-headed population fringes the fertile Mediterranean coast, with a tendency to spread up the Rhone Valley. In fact, these two areas of long-headed populations show a disposition to unite south of Lyons in a narrow light strip. This divides the dark-colored areas of Alpine people into two wings. One of these cen-

* It should not fail of notice that these maps are constructed from averages for each department as a unit. These last are merely administrative districts, entirely arbitrary in outline, and entirely in dissonance with the topography of the country. The wonder is that, in view of this, the facts should still shine out so clearly. Thus all the Rhone departments lie half up among the mountains on the east. Their averages are therefore representative neither of the mountains nor the valleys. Between Dijon and Lyons the departments completely span the narrow valley, entirely obliterating its local peculiarities.

ters in the Alpine highlands, running up to the north; the other, in Auvergne, extends away toward the Spanish frontier. At the present time let us note that this intrusive strip of long heads cutting the Alpine belt in two follows the exact course of the canal which has long united the head waters of the Loire with the Rhone. It is an old channel of communication between Marseilles and Orleans. Foreigners, immigrating along this highway, are the cause of the phenomenon beyond question.

The long-headed populations therefore seem to follow the open country and the river valleys. The Alpine broad-headed type, on the other hand, is always and everywhere aggregated in the areas of isolation. Its relative purity, moreover, varies in proportion to the degree of such isolation enjoyed or suffered. In Savoy and Auvergne it is quite unmixed; in Brittany only a few vestiges of it remain. And yet these few remnants are strictly confined within the inhospitable granitic areas, so that the boundaries of the two correspond very closely. The spoken Celtic tongue has also lingered here in Brittany for peculiar reasons, which we shall soon discuss. The main one is the isolation of the district, which has sheltered the Alpine race in the same way. For it is now beyond question that the Breton, the Auvergnat, and the Savoyard are all descendants of the same stock. In nearly every case the Alpine race is found distributed, as Dr. Collignon says, "by a mechanism, so to speak, necessary, and which by the fatal law of the orographic condition of the soil ought to be as it is." In the unattractive or inaccessible areas the broad-headedness centers almost exclusively; in the open, fertile plains the cephalic index falls as regularly as the elevation. So closely is this law followed that Dr. Collignon affirms of the central plateau that wherever one meets an important river easily ascended, the cephalic index becomes lower and brachycephaly diminishes.

The two-hundred-metre line of elevation above the sea seems most nearly to correspond to the division line between types. This contour on our geographical map is the boundary between the white and first shaded areas. Compare this map with that of the cephalic index, following round the edge of the Paris basin, and note the similarity in this respect. There is but one break in the correspondence along the eastern side. This exception it is which really proves the law. It is so typical that it will repay us to stop a moment and examine. We have to do, just south of Paris, with that long tongue of dark tint, that is of relative broad-headedness, which reaches away over toward Brittany. It nearly cuts the main axis of Teutonic racial traits (light tinted) in two. This is the department of Loiret, whose capital is Orleans. It is divided from its Alpine base of supplies by the long-

headed department of Yonne on the east. This latter district lies on the direct route over to Dijon and the Rhone Valley. Teutonic peoples have here penetrated toward the southeast, following the path of least resistance as always. Why, you will ask, is the Loiret about Orleans so much less Teutonic in type? The answer would appear were the country mapped in detail. The great forest of Orleans, a bit still being left at Fontainebleau, used to cover this little upland between the Seine and the Loire, east of Orleans. It was even until recently so thinly settled that it was known as the *Gatinais*, or wilderness. Its insular position is for this reason not at all strange. The Teutons have simply passed it by on either side. Those who did not go up the Seine and Yonne followed the course of the Loire. Here, then, is a parting of the ways down either side of Auvergne.

Another one of the best local examples illustrating this law that the Alpine stock is segregated in areas of isolation and of economic disfavor is offered by the Morvan. This "*mauvais pays*" is a peninsula of the Auvergne plateau, a little southwest of the city of Dijon. It is shown on our geographical map. It is a little bit of wild and rugged country, about forty miles long and half as wide, which rises abruptly out of the fertile plains of Burgundy. Its mountains, which rise three thousand feet, are heavily forested. The soil is sterile and largely volcanic in character; even the common grains are cultivated with difficulty. The limit of cultivation, even for potatoes or rye, is reached by tilling the soil one year in seven. This little region contains at the present time a population of about thirty-five thousand—less to-day than fifty years ago. Until the middle of the century there was not even a passable road through it. It affords, therefore, an exceedingly good illustration of the result of geographical isolation in minute detail. Its population is as strongly contrasted with that of the plains round about as is its topography. The people, untouched by foreign influence to a considerable extent, have intermarried, so that the blood has been kept quite pure. The region is socially interesting as one of the few places in all France where the

TYPES IN THE MORVAN.

birth rate long resisted the depressing influences of civilization. For years it has been converted into a veritable foundling asylum for the city of Paris. Its mothers have cared for innumerable waifs besides their own offspring. This isolated people is strongly Alpine, as our portraits show, the boy on the right being a peculiarly good type; the other one has a strain of Teutonic narrow-headedness from all appearances. Beyond a doubt here is another little spot in which the Alpine race has been able to persist by reason of isolation alone.*

The law which holds true for most of France, then, is that the Alpine stock is confined to the areas of isolation and economic unattractiveness. A patent exception to this appears in Burgundy—the fertile plains of the Saone, lying south of Dijon. A strongly marked area of broad-headedness cuts straight across the Saone Valley at this point. A most desirable country is strongly held by a broad-headed stock, although it is very close to the Teutonic immigration route up along the Rhine. Here we have a striking example of the reversion of a people to its early type after a complete military conquest. It serves as an apt illustration of the impotency of a conquering tribe to exterminate the original population. The Burgundians, as we know, belonged to a blond and tall race of Teutonic lineage, who came to the country from the north in considerable numbers in the fifth century. The Romans welcomed them in Gaul, forcing the people to grant them one half of their houses, two thirds of their cultivated land, and a third of their slaves. For about a thousand years this district of Burgundy took its rule more or less from the Teutonic invaders: and yet to-day it has completely reverted to its primitive type of population. It is even more French than the Auvergnats themselves. The common people have virtually exterminated every trace of their conquerors. Even their great height (shown on our stature map), for which the Burgundians have long been celebrated, is probably more to be ascribed to the material prosperity of the district than to a Teutonic strain. One factor contributing to the result we observe is that the fertile country of the Saone Valley is open to constant immigration from Switzerland and the surrounding mountains. The Rhine has drawn off the Teutons in another direction, and political hatreds have discouraged immigration from the northeast. The result has been that the Alpine type has been strongly

* It should be noted that this relation does not appear upon our map of head form, because this represents merely the averages for whole departments. The Morvan happens to lie just at the meeting point of three of these, so that its influence upon the map is entirely scattered. Most interesting details are given in Mémoires de la Société d'Anthropologie, Series 3, I, 1894, fasc. 2.

re-enforced from nearly every side, while Teutonic elements have been gradually eliminated.

Another and perhaps even more potent explanation for this localization of the Alpine type in Burgundy also lies at hand. This fertile plain is the last rallying point of a people repressed both from the north and the south. The general rule, as Canon Taylor puts it, is that the "hills contain the ethnological sweepings of the plains." This holds good only until such time as the hills themselves become saturated with population, if I may mix figures of speech. Applying this principle to the present case, it appears as if the original Alpine stock in Burgundy had been encroached upon from two sides. The Teutons have overflowed from the north; the Mediterranean stock has pressed up the Rhone Valley. Before these two the broad-headed Alpine type has, as usual, yielded step by step, until at last it has become resistant, not by reason of any geographical isolation or advantage, but merely because of its density and mass. It has been squeezed into a compact body of broad-headedness, and has persisted in that form to the present time. It has rested here, because no further refuge existed. It is dammed up in just the same way that the restless American borderers have at last settled in force in Kansas. Being in the main discouraged from further westward movement, they have at last taken root. In this way a primitive population may conceivably preserve its ethnic purity, entirely apart from geographical areas of isolation as such.

What is the meaning of this remarkable differentiation of population? Why should the Alpine racial type be so hard favored in respect of its habitat? Is it because prosperity tends to make the head narrow; or, in other words, because the physical environment exerts a direct influence upon the shape of the cranium? Were the people of France once completely homogeneous until differentiated by outward circumstances? There is absolutely no proof of it. Nevertheless, the coincidence remains to be explained. It holds good in every part of Europe that we have examined—in Switzerland, the Tyrol, the Black Forest—and now here in great detail for all France. Two theories offer a possible and competent explanation for it all. One is geographical, the other social.

The first theory accounting for the sharp differences of population between the favorable and unpropitious sections of Europe is that the population in the uplands, in the nooks and corners, represents an older race, which has been eroded by the modern immigration of a new people. In other words, the Alpine Celts once occupied the land much more exclusively; they were the primitive possessors of the soil. From the north have come the Teu-

tonic tribes, from the south the Mediterranean peoples; in France, just as in the Tyrol, as we have pointed out in a preceding paper. The phenomenon, according to this theory, is merely one of ethnic stratification.

A second explanation, much more far reaching in its prognosis, is, as we have said, sociological. The phenomenon is the outcome of a process of social selection, which rests upon racial or physical differences of temperament. This theory is advanced by Ammon of Baden, and his disciple Lapouge in France, in two very remarkable recent books.* Briefly stated, it is this: In some undefined way the long-headed type of head form is generally associatad with an energetic, adventurous temperament, which impels the individual to migrate in search of greater economic opportunities. The men thus physically endowed are more apt to go forth to the great cities, to the places where advancement in the scale of living is possible. The result is a constant social selection, which draws this type upward and onward, the broad-headed one being left in greater purity thereby in the isolated regions. Those who advocate this view do not make it necessarily a matter of racial selection alone. It is more fundamental. It concerns all races and all types within races. This is too comprehensive a topic to be discussed in this place; we shall hope to deal with it later. Personally, I think that it may be, and indeed is, due to a great process of *racial* rather than purely *social* selection. I do not think it yet proved to be other than this. The Alpine stock is more primitive, deeper seated in the land; the Teutonic race has come in afterward, overflowing toward the south, where life offers greater attractions for invasion. In so doing it has repelled or exterminated the Alpine type, either by forcible conquest or by intermixture, which racially leads to the same goal.†

Before we proceed further let us examine the other physical traits a moment. The map of the distribution of brunetteness shows these several Alpine areas of isolation far less distinctly than the map of the cephalic index. It points to the disturbing influence of climate or of other environment. If the law conducing to blondness in mountainous areas of infertility were to hold true here as it appears to do elsewhere, this factor alone would obscure relations. Many of the populations of the Alpine areas should, on racial grounds, be darker than the Teutonic ones; yet, being economically disfavored, on the other hand, they tend toward blondness. The two influences of race and environment

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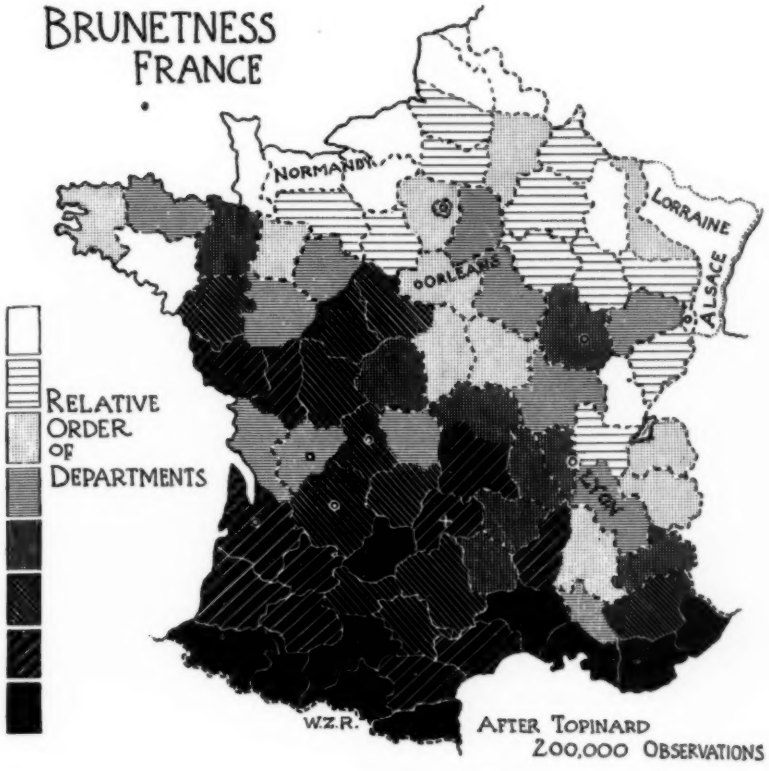
* Natürliche Auslese beim Menschen, Jena, 1893. Les Sélections Sociales, Paris, 1896.

† For an exceedingly interesting discussion of the action of economic and social forces in France, *vide* Auvergne, by T. E. Cliffe-Leslie in Fortnightly Review, xvi, p. 736 *seq.*

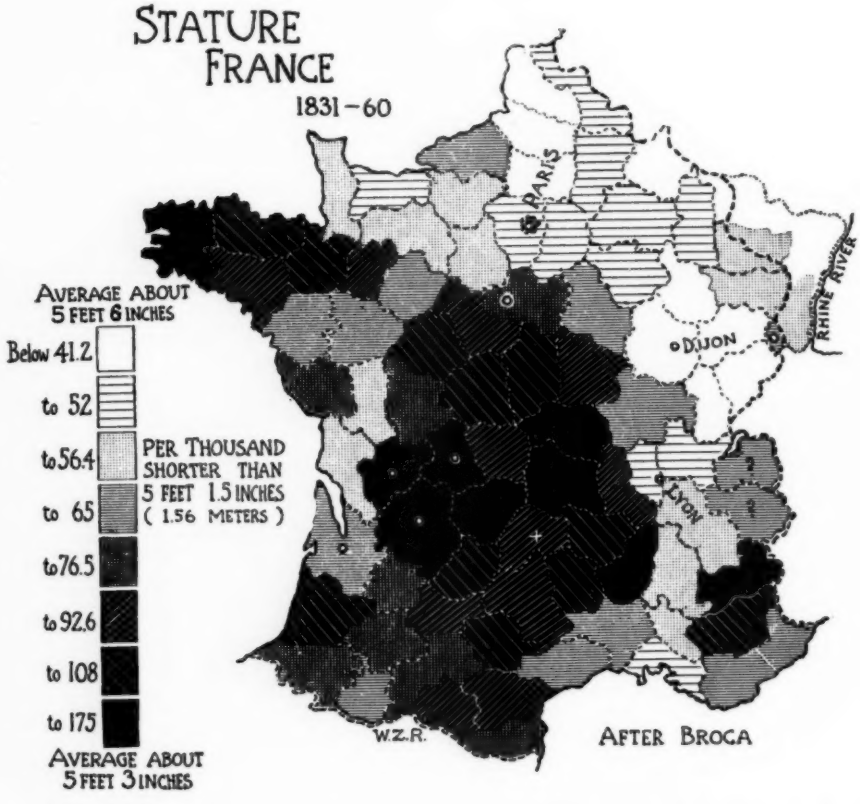
are here in opposition to the manifest blurring of all sharp racial lines and divisions. Despite this disturbing influence, the Auvergnat area appears as a great wedge of pigmentation penetrating the center of France on the south. This is somewhat broken up on the northern edge, because of the recent immigration of a considerable mining population into this district which has come



from other parts of the country. The Rhone Valley appears as a route of migration of blondness toward the south. Little more than these general features can be gathered from the map of color, except that the progressive brunetteness as we advance toward the south is everywhere in evidence. Were we to examine the several parts of France in detail we should find competent explanations for many features which appear as anomalous—as, for example, the extreme blondness upon the southwest coast of Brittany.

The map of stature still preserves evidence of the threefold division of the short Alpine people into Savoyards, Auvergnats, and Bretons. It demonstrates in great clearness the influence of the Rhone Valley in the production of tall stature. In this case the process is cumulative, for the fertile valley productive of in-

creased bodily height is at the same time a highroad of immigration for the Teutonic race, which always carries a tall stature wherever it goes. The main axis of fertility from Paris to Bor-

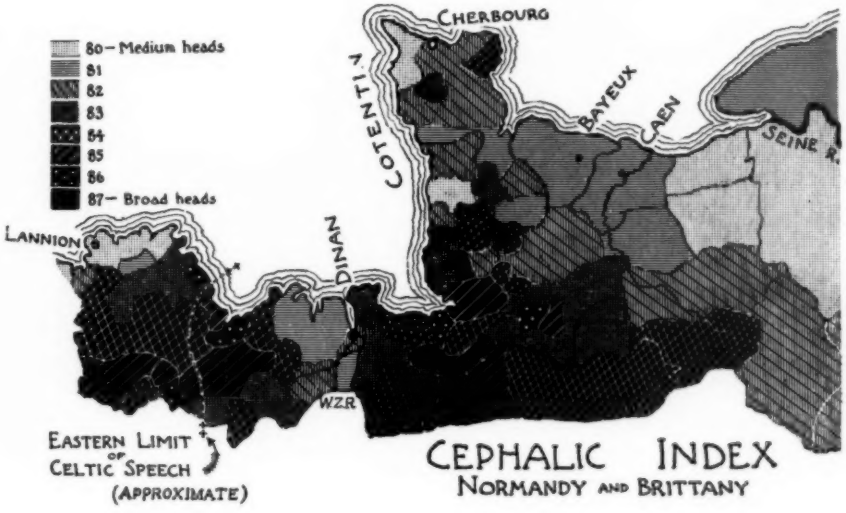


deaux does not appear, for two reasons. The area about Limoges and Perigueux (see map of cephalic index on page 293), with the shortest population of all, is the seat of a prehistoric people which we shall describe in our next paper; and north of it toward Orleans local causes with which we have not time to deal here have been operative.

Brittany and *Normandy* are two of the most interesting regions in Europe to the traveler and the artist. The pleasing landscapes and the quaint customs all serve to awaken interest. To the anthropologist as well the whole district possesses a marked individuality of its own. Within it lie the two racial extremes of the French people—the old and the new—closely in contact with one another. Attention was first attracted to the region because of the persistence of the Celtic spoken language, now vanished everywhere else on the mainland of Europe—quite ex-

tinct, save as it clings for dear life to the outskirts of the British Isles. Here again, we find an ethnic struggle in process, which has been going on for centuries, unsuspected by the statesmen who were building a nation upon these shifting sands of race. This struggle depends, as elsewhere in France, upon the topography of the country. The case is so peculiar, however, that it will repay us to consider it a little more in detail.

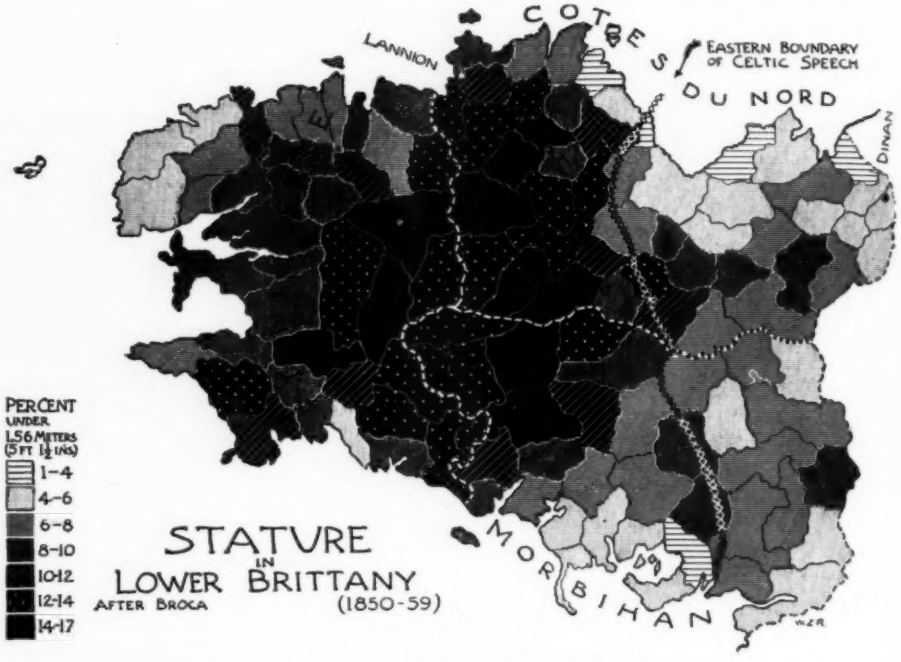
The anthropological fate of Brittany, this last of our three main areas of isolation, depends largely upon its peninsular form. Its frontage of seacoast and its many harbors have rendered it peculiarly liable to invasion from the sea; while at the same time it has been protected on the east by its remoteness from the economic and political centers and highways of France. This coincidence and not a greater purity of blood has preserved its Celtic speech. Since the foreigners have necessarily touched at separate points along its coast, concerted attack upon the language has been rendered impossible. This fact of invasion from the sea has divided its people not into the men of the mountain distinct from those of the plain—a differentiation of population, by the way, as old as the reforms of Solon and Cleisthenes. The contrast has arisen between the seacoast and the interior. The people of the inland villages contain a goodly proportion of the Alpine stock, although, as our maps show, it is more attenuated than in either Savoy or Auvergne. To the eye this Alpine lineage appears in a



roundness of the face, a concave nose in profile, and broad nostrils. Along the coast intermixture has narrowed the heads, lightened the complexion, and, perhaps more than all, increased the stature. For an example of these contrasts our maps will

serve as an illustration. We have already made use of one in a preceding paper. It is reproduced for purposes of comparison.

In view of the nature of these physical changes induced by ethnic crossing along the seacoast, we must look to the Teutonic race for the lineage of the invaders. They must, on the whole, have been light and long-headed. History, in this case, comes to our aid. The Saxon pirates skirted the whole coast around to the mouth of the Loire. In fact, they were so much in evidence that part of it was known to the old geographers as the *litus Saxonicum*. The largest colony which has left permanent traces of its invasion in the character of its present population, although



Cæsar assured us that he exterminated it utterly, is located in Morbihan. This department on the south coast of the peninsula, as our map of coloration of all France shows, is one of the blondest in all France. Its capital, Vannes, derives its name from the Venetes, whose confederation occupied this area. Both Strabo and Diodorus of Sicily asserted that these people belonged to the Belgæ (Teutonic stock), although modern historians of Gaul seem inclined to deny it. Our anthropological evidence is all upon the side of the ancient geographers.

From a different source, although due indirectly to these same Teutonic barbarians, are derived the physical characteristics of the people in the north of Brittany, near Dinan, in the valley of the Rance. Its location appears upon both of our maps of Brittany.

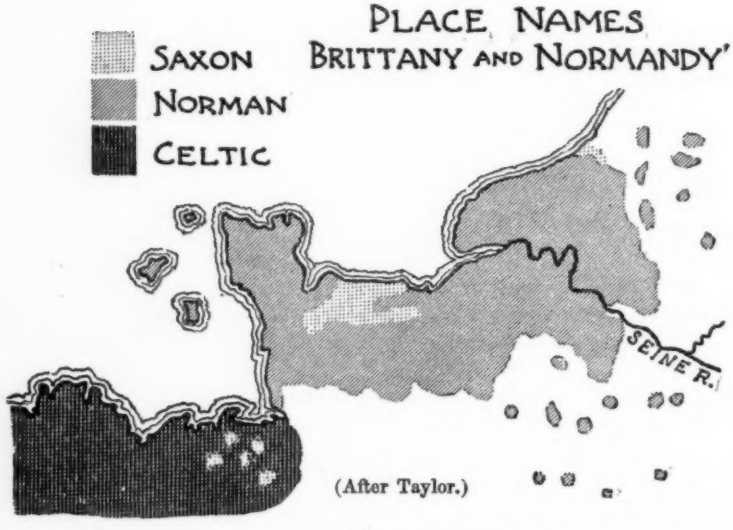
This little district is very distinct from the surrounding country. The landscape also is peculiar in many respects. The cottages are like the English, with hedgerows between the several plots of ground. All these outward features corroborate the anthropological testimony that this was a main settlement of the people who came over from Cornwall in the fifth century, ousted by the Anglo-Saxons. They, in fact, gave the name Brittany to the whole district. They spoke the Celtic language in all probability, but were absolutely distinct in race. They seem to have been largely Teutonic. The Saxons soon followed up the path they laid open, so that the characteristics of the present population are probably combined of all three elements. At all events, to-day the people are taller, lighter, narrower-nosed, and longer-headed than their neighbors. A similar spot of narrow-headedness appears upon our map at Lannion. The people here are, however, of dark complexion, short in stature, characterized by broad and rather flat noses. Here is probably an example of a still greater persistence in ethnic traits than about Dinan, for the facts indicate that here at Lannion, antedating even the Alpine race, is a bit of the prehistoric population which we promise to identify in the next paper.

Normandy is to-day one of the blondest parts of France. It is distinctly Teutonic in the head form of its people. In fact, the contrast between Normandy and Brittany is one of the sharpest to be found in all France. The map of cephalic index on page 293 shows the regularly increasing long-headedness as we approach the mouth of the Seine. In the Norman departments from thirty to thirty-five per cent of the hair color is dark; in the adjoining department of Cotes-du-Nord, in Brittany, the proportion of dark hair rises from forty to sixty, and in some cases even to seventy-five per cent. In stature the contrast is not quite as sharp, although the people of the seacoast appear to be distinctly taller than those far inland. The ordinary observer will be able to detect differences in the facial features. The Norman nose is high and thin; the nose of the Breton is broader, opening at the nostrils. In many minor details the differences are no less marked.

Normandy, on the whole, is an example of a complete ethnic conquest. At the same time, while a new population has come, the French language has remained unaffected, with the exception of a spot near the city of Bayeux, where the Saxons and Normans together combined to introduce a bit of the Teutonic tongue. This conquest of Normandy has taken place within historic times. It is probably part and parcel of the same movement which Teutonized the British Isles; for it appears that the Normans were the only Teutonic invaders who can historically be traced to this

region. Wherever they left the country untouched, the population approaches the Alpine type, being darker, broader-headed, and shorter in stature. This indicates that the tribes, such as the Caletes (the city of Caux), the Lexovii (Lisieux), and the Baiocasses (Bayeux) in Cæsar's time were probably of this latter type; in other words, that the district was Alpine in population until the Normans came with Rollo in the tenth century. The Romans appear to have allowed the Saxons to settle at places along the seacoast, but they had never penetrated deeply into the interior.

The correspondence between the map of Norman place names and that of cephalic index is sufficiently close to attest to the value of each. One of the common features of the Teutonic village names is "ville," from "weiler," meaning an abode, and not from "villa," of Romance origin. This suffix appears, for ex-



ample, in Haconville, or in a corrupted form in Hardivilliers. Another common ending of place names is *bœuf*, as in Marbœuf. Dr. Collignon has traced out a considerable number of such place names of Norman origin, all of which point to the Cotentin—that distinct peninsula which juts out into the English Channel—as a center of Norman dispersion. Certain it is that Cherbourg, at its extremity, shows the Norman element at its maximum purity. Probably this was a favorite base of supplies, protected by its isolation and in close proximity to the island of Jersey, which the Normans also held. The Saxon colony near Caen was a factor also which determined this location. The extension of the Normans to the west seems to have been stopped by the human dike set up by the English and Saxons about Dinan, and by "Norman Switzerland," the hilly region just east of it. Follow the

similarity between the boundary of long and narrow heads on our map of cephalic index of Brittany, and the cross-hatched lines and tints on the map of physical geography of France on page 291. Note how it cuts across diagonally from northwest to southeast, parallel to the course of the Seine. Here the economic attraction in favor of the invasion of Brittany ceased, and at the same time the displaced natives found a defensible position. Prevented from extension in this direction, the Normans henceforth turned toward the Seine, where, in fact, their influence is most apparent at the present time. Paris, the Mecca of all invaders, toled them away, and Brittany was saved.

FORECASTING THE PROGRESS OF INVENTION.

By WILLIAM BAXTER, Jr.

THE great progress made during the last fifty years in the domain of science and invention has aroused a very general desire among intelligent people to know what the future has in store, and in many cases the desire has become so strong as to develop prophetic tendencies. Whenever a banquet is given in commemoration of some scientific event, or upon the anniversary of some ancient and honorable society, the orator of the evening is sure to dwell at considerable length upon the great discoveries that are still to come. By contrasting the extraordinary advances made during the last century with the comparatively limited progress of all previous time, and by showing that the rate of advancement has been continually increasing during the latter period, he arrives at the conclusion that in the years to come development will increase in a compound ratio, and the discoveries will become so numerous and so great as to dwarf into insignificance all that has been accomplished up to the present time.

Writers who dwell upon these glorious achievements of mankind in modern times follow the same vein, and make equally extravagant predictions as to the future. If these writers and orators would stop when they reach this point in their meditations they would be wise, since it is a self-evident fact that progress in science and invention has been increasing very rapidly during the last fifty or sixty years, and certainly there is no reason to suppose that we have reached the end, and that henceforth development will be very slow; but at this point the spirit of prophecy seizes them, and they proceed to describe the wonders yet unseen. It is here that they almost invariably fail. They would not be satisfied if they assumed that future progress would

be along the lines of possible development—that would be too commonplace and altogether out of keeping with the ideal of the greatness of the future achievements of mankind. They must necessarily assume that what is brought forth hereafter will be so far in advance of what we now know of as to be revolutionary in its character, and so much so, in fact, as to consign to the scrap heap the most perfect devices of the present time. Some of the means by which these results are to be attained are not capable of accomplishing such wonders; others, while of great theoretical possibilities, are surrounded by certain practical difficulties so well understood at the present time that we can almost with certainty say that they will never realize the dreams that are based upon them. The remainder are problems that can be solved to-day, and would be if it were not for the fact that it is by no means certain that their solution would be of any practical value. The improbability of ever realizing a substantial gain by the solution of many of the problems upon which prophecies as to the wonders of the future are based is fully appreciated by many of those who have given the subject careful consideration; but those who dream of the revolutionary character of future invention never take note of such things.

Nearly all those who succumb to the fascination of meditating upon the changes that may be wrought by inventive genius in days to come follow the same line of thought. The problems upon the solution of which their fancy paints its pictures are always the same, although some contemplate the whole category, while others only dwell upon a portion thereof. These problems are aërial navigation, the development of electric energy direct from coal or some other equally cheap substance, and the utilization of the various forces of Nature, such as solar heat, tide and wave motion, and wind currents. Of these, aërial navigation is supposed to be by far the most important, obtaining electricity direct from coal and the others following along in the order in which they are given above.

As to the utilization of solar heat, tides, wave motion, and wind currents, it can be truthfully said that they could be utilized at the present time if it were considered profitable to do so. The energy of wind currents, as every one knows, is made available on a very extensive scale, but always in small units, and this fact alone shows that it can not compete with the steam engine, which, according to the prophets, it is sure to supersede. The energy of tides and wave motion is also utilized to some extent, and solar engines have been made from time to time.

It can not be said that these unlimited sources of energy are not brought into the service of man because of our inability to devise apparatus with which to harness them successfully, for, as

a matter of fact, a great deal of ingenuity has been displayed in this direction, and the cost of the mechanism, with reference to the power recovered, has probably been reduced to nearly as low a point as is possible. In the matter of simplicity and durability equally good results have been obtained.

An analysis of the most salient features of these forms of energy will show why they are not utilized on a more extensive scale. The power of waves and tides is only available along the seacoast, where, as a rule, power is not in demand; furthermore, any kind of apparatus made to utilize this energy must be very strong and bulky in comparison with the power it will give, and as a consequence very costly. In addition to this, the amount of energy will vary greatly at different seasons; hence the output that can be depended upon at all times must be far below the actual capacity of the apparatus. A further drawback is the great irregularity of the power, which renders it of little value unless means are provided for reducing it to a delivery at a uniform rate.

Windmills are not so much restricted, as to location, as the foregoing, but they are very large in comparison to the work they can do, and, as the velocity of the wind may drop to nearly zero for a long period of time, their average capacity, taking the year through, may be exceedingly small.

Solar energy is available everywhere, but the capacity of an apparatus made to utilize it would be very indefinite and far below its maximum, owing to the fact that cloudy weather may come at any time and continue for days or even weeks.

The irregularity of the power derived from these sources can be overcome by resorting to some form of storage, but this would not help, except to a limited extent, to increase the average output; therefore, when the apparatus was working at its full capacity, there would be a large surplus of power going to waste. By increasing the capacity of the storage reservoirs, the average output could be increased, and if the intervals of time during which the energy developed is little or nothing were short, say two or three days, and were followed by corresponding intervals of maximum output, it would probably be profitable to make the capacity great enough to store all the surplus developed at times of maximum output; but, as these periods may each extend over two or three weeks, it is evident that about the best we can do is to increase the average output slightly by using a greater storage capacity.

As these natural forms of energy can be obtained without cost, and the fuel used by a steam engine has to be purchased, it is apparently reasonable to assume that they would constitute a more economical form of power, but wherever a constant supply is de-

sired it is very doubtful whether the economy of the steam engine can be superseded by any one of them. It is true that there is no expenditure for fuel, but the interest on the extra cost of the plant and the maintenance thereof, as well as the additional space required, may more than offset this gain; and the fact that so little is done in the way of utilizing them would seem to show that up to the present time their value has failed to make any great impression upon engineers who have looked into the subject. It does not follow from this that they will never come into use on a more extensive scale than at present, but it does follow that the dreams of those who believe that they will eventually supersede all forms of prime movers that consume fuel will never be realized. Through the increased value of fuel or the reduced cost of construction of the apparatus, or both, they may become competitors to a greater or less extent, but more than this can not be expected.

Considering, now, the effects of the solution of the problem of obtaining electricity direct from coal, it can be said that it is far more likely to revolutionize the affairs of the world than the utilization of the natural forms of energy; but it must also be said that we are not justified, in view of what is now known in relation to the subject, in assuming that it will ever realize the predictions of the oversanguine prophets. If we could solve the problem according to our ideal, all that is expected of it would be accomplished; but such a solution is highly improbable, if not actually impossible. Our ideal battery would be as simple as a boiler, and be provided with a place where coal could be fed in and another through which the residue could be removed. In a boiler, the pressure of the steam, as well as the quantity generated, can be increased by simply increasing the size of the fire box, but this simplicity could not be obtained even in our ideal battery, because the electromotive force would remain the same no matter how much the size of the cell might be increased. To obtain an electromotive force high enough for practical purposes it would be necessary to use a large number of cells, and, to feed these without too much trouble, it would be necessary to devise an automatic feeder capable of operating with a degree of perfection hardly obtainable without the aid of human intelligence.

It may be permissible to dream of such perfection, but we are not justified in assuming that it is possible. Electricity can be obtained from chemical action only when the material acted upon is in the electric circuit. If two metals are placed in a solution that can decompose one of them, an electric current will flow in a wire the ends of which are attached to the two metals. If two solutions capable of acting upon each other are separated by a porous partition, and into each a plate attached to a wire is im-

mersed, a current will flow. If in a solution two metals that are not acted upon are immersed, a current will not flow in a wire connecting them. If into this solution pieces of metal or other substances that will be acted upon are dropped, no current will be generated, because the chemical action takes place between substances one of which is not in the electric chain. Coal is not a conductor of electricity, in the practical sense; therefore it can not be used directly in the electric circuit, even if we could find a way to oxidize it satisfactorily; hence the only probable way of solving the coal-battery problem is by some indirect process, and this may introduce complications great enough to entirely offset all the advantages.

The belief that great development will be made along the lines discussed in the foregoing is confined to those who possess some familiarity with scientific matters, but the general run of intelligent people only have a vague idea of what may be expected from these sources, and the pictures drawn by their imagination in relation thereto are decidedly hazy; with them the greatest of all future achievements is the solution of the problem of aërial navigation. This belief is undoubtedly due to the fact that the theoretical limitations are not understood, or are not taken into consideration, and as a consequence the average conception of a perfect air ship, as well as its movements and velocity, is very different from the actual possibilities.

The most striking difference between imagination and possibility, in this line, is perhaps in the relation between the size of the ship and its carrying capacity, the latter being always greatly magnified. An examination of any considerable number of the illustrations of flying machines would show this point very forcibly. In many of these pictures the force of gravity is treated with the utmost contempt, the ship being made apparently of sheet iron, very similar in shape to a submarine torpedo boat, the sustaining power being obtained by means of one or more moderate-sized propellers mounted upon vertical shafts, or else equally small aëroplanes. In those designs that display a greater regard for the laws of Nature, the disparity in the proportions is not so great, but in all of them it is very decided.

It is evident that with our present knowledge of science there are only two ways in which an air ship can be kept afloat, one by the use of a balloon and the other by means of aëroplanes. In the former the sustaining capacity is small relatively to the volume, being about one pound for every fourteen cubic feet; and with the latter it is small relatively to the surface, being probably not over one pound to the square foot. From this it can easily be seen that the carrying capacity, even of a craft of large dimensions, must be small, very much smaller than the popular notion

would make it. The sketch presented herewith will give a fair idea of the difference between reality and the general ideal, the small car shown in solid lines being large enough to carry all the passengers or freight that the balloon could sustain, and the one in dotted lines about the size generally shown in illustrations of air ships. The sketch is not above criticism, since it does not give the location of the motor or any means for revolving the propeller, but that is a peculiarity of the majority of air-ship pictures, and the writer may be pardoned for following a common custom,

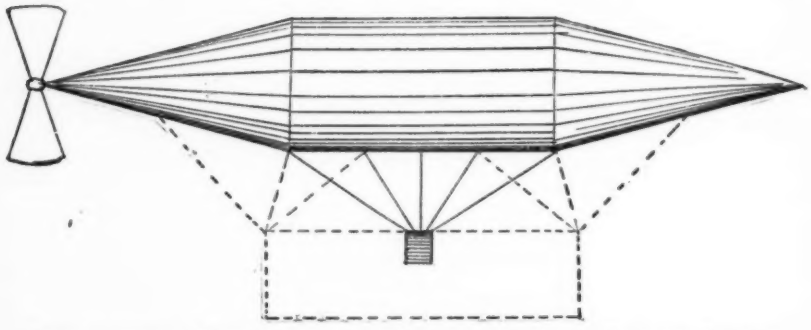


DIAGRAM SHOWING DIFFERENCE BETWEEN SUPPOSED AND ACTUAL CARRYING CAPACITY OF AIR SHIPS.

especially as the object of the sketch is only to show the relation between size and carrying capacity.

That this sketch is not exaggerated can be easily shown. The balloon is supposed to be one hundred and twenty feet long and twenty feet in diameter, the taper at each end being forty feet. From these dimensions it will be seen that the displacement is about twenty-one thousand feet, and the sustaining capacity about fifteen hundred pounds. Now, the first thing that any conservative engineer would admit would be that the apparatus could not be constructed within this weight if the same factor of safety were used as is customary in designing any ordinary structure; hence, if any carrying capacity is to be obtained, the weight and strength of every part must be reduced to a point not regarded as permissible in ordinary practice. Following this course, we can assume the weight of the whole ship at one thousand pounds, which would certainly be light considering its size; we would then have a net carrying capacity of five hundred pounds—equal to, say, four men. The car is drawn four foot square and six feet high, which is ample for four passengers. A contemplation of the difference between the size of the balloon and the car is enough to dampen the ardor of the most enthusiastic believer in the possibilities of aërial navigation.

It may be claimed that by the use of aëroplanes the size can

be considerably reduced, but this is doubtful; and if it can, it probably would not be any benefit, since, if the area of the planes is reduced, the pressure must be increased, and this would result in a less efficient application of the energy required to keep the ship in the air. Another mistaken notion that is accountable in a great measure for the belief in the wonderful possibilities of aërial navigation is that great velocity could be obtained. This assumption is entirely erroneous, and as a matter of fact it can be easily shown that higher speed can be attained on a railroad. As is perfectly well known, the principal obstacle that stands in the way of extraordinary velocity on railroads is the resistance of the atmosphere, and this would be very much greater in the case of an air ship owing to the increased size. The cross-section of a train of cars is less than one hundred and fifty feet, while that of an air ship of the same carrying capacity would probably be ten times as great if not more, and the power required to overcome atmospheric resistance would be in about the same proportion. From this it can be seen that the energy necessary to propel the ship, without saying anything about that required to keep it in the air, would be many times greater than that required to drive a train of cars at the same speed; hence, as a means of rapid transit, aërial navigation could not begin to compete with the railroad.

There is another direction in which the air ship would be seriously defective, and this is almost always overlooked, and that is in the matter of making landings. Being a large body, it would necessarily be unwieldy, and its motion in any direction could not be arrested in a very short space of time; therefore it could not make a landing within a limited area. In a dead calm it could probably be lowered in nearly a vertical line, and thus make a landing in a contracted space, but if the wind were blowing even at a moderate velocity the case would be different. As the wind is always blowing more or less, and as it frequently changes its course in a few seconds, the ship would be tossed about quite lively before it reached the ground. If it came down at the rate of three hundred feet per minute, which is a high velocity, and the wind were blowing at the rate of ten miles per hour, the side drift would be three times as great as the vertical descent; and if this were counteracted by imparting a velocity to the ship equal to that of the wind and opposed to it, the side draught would be doubled if the direction of the wind should suddenly reverse. It must therefore be evident that to be able to make a landing safely, without running the risk of colliding with church steeples and modern sky-scrapers, it would be necessary to have a large open space, and in order that the passengers might not have to walk a large portion of the length of their journey convey-

ances would have to be provided to transport them from the place where the ship might land to the station entrance.

It must not be assumed from what has been said in the foregoing that the writer regards the solution of the problems here considered as of no special value, for his views are just the opposite of this. The object aimed at has been to show that the wonderful things that it is expected will be accomplished by the solution of these problems will never be realized with regard to some because they are not possible, and are not likely to be realized by the others on account of inherent defects that the solutions may bring to light. The coal-battery problem will, no doubt, be worked out, in some form or other, but who can tell whether the objectionable features of it will or will not offset all its advantages? The hot-air engine is a far more perfect converter of energy, in theory, than the steam engine, but its defects when reduced to a practical form are such that it is of no value except for small power, and this may also turn out to be the case with the coal battery. The utilization of the energy of tides, solar heat, etc., is as possible to-day as at any future time; the fact that they are not utilized is proof that they are not considered as desirable as other forms of energy. In the future the cost of the apparatus for harnessing them may be so reduced as to render them available to a much greater extent than at the present time, but that they will ever revolutionize the industrial affairs of the world and drive the steam engine out of use is hardly a remote possibility. Aërial navigation will, no doubt, be accomplished, but in the opinion of the writer it will never be used for commercial purposes, simply because it can not, even if developed to the highest state of perfection, compete with transit on the surface of the earth, either in speed or cost of transportation. It may be used in warfare, but more than likely it will be confined to pleasure purposes.

THE highest value can obviously be given to present research by directing it chiefly to those departments which are undergoing most rapid changes and therefore most urgently demand immediate study. The subject is thus regarded by Prof. A. C. Haddon, who, trying to put himself at the point of view of our successors a hundred or a thousand years hence, asks, in Nature, what they would wish we had done. Studies in the structure, development, and physiology of animals, polar research and deep-sea research, will not suffer materially if the pursuit of them is delayed; but "our first and immediate duty is to earn for science vanishing knowledge; this should be the watchword of the present day." In this category are the study of native fauna and flora before they are exterminated or crowded out or mixed with introduced species, and the study of native man before he is contaminated by contact with civilization. The opportunity for these studies is diminishing, and once lost can never be recovered.

SOME FACTS ABOUT WASPS AND BEES.

By Dr. R. W. SHUFELDT.

ONE of the most extensive and at the same time one of the most interesting groups of insects in the entire range of entomology is that order which has been created to contain the ants, bees, and wasps with their numerous allies. This association was called the *Hymenoptera* by Linnæus, the name having reference to the fact that the anterior and posterior wings of the winged forms are, during flight, connected together by a row, upon either side, of small hooks. This is Kirby's suggestion (Text-book of Entomology, page 103), but it would seem more probable that the word *Hymenoptera* was derived from the Greek *hymen*, a membrane, and *ptera*, wings.

Primarily, this order is divided into the *Terebrantia* and the *Aculeata*. In the first named the ovipositor is employed as a borer, while in the second it has become modified into a sting. These two subsections are by various classifiers again divided into several other divisions, and these again into families, genera, etc., as in the case of other natural alliances of animals. Both the habits and structure of the insects included in this group are characterized by great variety, and the majority of its members exhibit an extraordinary amount of intelligence, especially this being true in the case of the ants and wasps. A perfect host of parasitic insects also belong to this group, attacking both the larvæ and eggs of other insects. Were all the literature extant that has been devoted to the ants alone got together, it would form by no means a small library; but such a library would be completely overshadowed were it compared with a similar one collected in the case of bees. Of the common honeybee alone, Mr. John Hunter, the late Secretary of the British Bee Keepers' Association, has said: "No nation upon earth has had so many historians as this remarkable class of insects. The patience and sagacity of the naturalist have had an ample field for exercise in the study of the structure, physiology, and domestic economy of bees; their preservation and increase have been objects of assiduous care to the agriculturist; and their reputed perfection of policy and government have long been the theme of admiration, and have supplied copious materials for argument and allusion to the poet and the moralist in every age. It is a subject that has been celebrated by the Muse of Virgil and illustrated by the philosophic genius of Aristotle. Cicero and Pliny record that Aristomachus devoted sixty years to the study of these insects, and Philiscus is said to have retired into a remote wood that he might pursue his observations on them without interruption. A

very great number of authors have written express treatises on bees, periodical works have been published relating exclusively to their management and economy, and learned societies have been established for the sole purpose of conducting researches on this subject." When we have such facts as these before us one is enabled to form some estimate as to what the literature of the entire order *Hymenoptera* would amount to as a whole.

Nor has the historical naturalist neglected the wasps in his labors, for the literature upon these remarkable insects is likewise very voluminous. They constitute the true *Hymenoptera aculeata*, Kirby using the term *Diploptera*, dividing them into three families. Of these, the social wasps (*Vespidæ*) are represented by a number of genera in various parts of the world, containing a host of interesting species. Some of these are of small size, while others stand among the biggest of the entire group. One form found in China and Japan measures two inches across the wings. Many of these wasps sting with great severity, and it has been related of Mitchell, the Australian explorer, that he was stung by a species found in that country, and the pain caused thereby forced him to scream out with agony. It had the effect of temporarily paralyzing his leg, and the great spot on the limb occasioned by the injected poison did not disappear for at least six months. Many wasps are brilliantly colored, while the external structural parts of others are extremely unique. For example, the *Masaridæ* of Africa and Australia is a family in which the antennæ present a great variety of shapes, some of them even being clubbed, while others are extremely long and slender. Numerous species of wasps and hornets are fossorial by habit, either constructing underground burrows for themselves or else occupying those formed by other insects. Some of these types are very large, some are small, some are solitary by habit, others live in communities. We have one big species of fossorial wasp that I have studied at

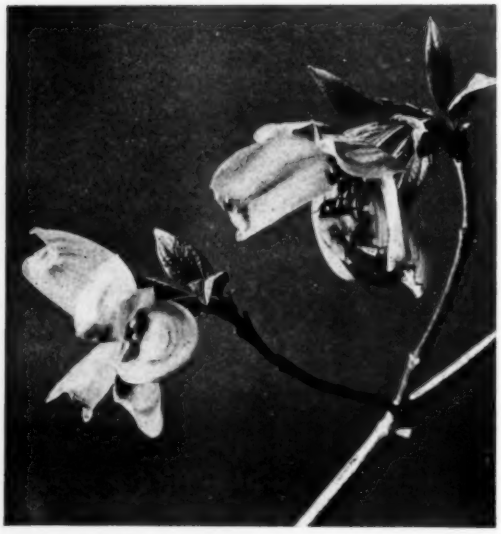


FIG. 1.—BUMBLEBEE UPON DOGWOOD FLOWER.
From a photograph taken life-size by Dr. Shufeldt and considerably reduced.

various points in the Atlantic coast States. Last spring there was a large colony of these established beneath the sweeping limbs of a fir tree near the main entrance to the Smithsonian Institution. The ground in this locality was riddled with their burrows. A great many cases of the sting of this formidable wasp are known to me. Years ago I knew of a case where a passenger upon a Mississippi River boat was stung by one of them on the back of the neck, and the man died eventually from the effect of it. The insect was knocked down on the deck at the time, and was found to be bearing a large cicada in its mandibles.

Some of the smaller fossorial wasps appear like large ants, the females being without wings. They also have a sting, and are clothed with a fine hairy coat, often of a bright yellow or brilliant vermilion. In New Mexico, in sandy places, I frequently saw these insects, but never more than one at a time, and only a few in the course of a day. They have been called "solitary ants" (*Mutilla* ?). There are hundreds of species in the world of these fossorial wasps, some winged, others wingless; some very small, others measure three or four inches across the wings (*Pepsis*, etc.); while many of them exhibit the most wonderful coloring in metallic blues, greens, reds, and yellow. Nearly all have the habit of paralyzing other insects by stinging them, then carrying their helpless victims to their subterranean nests, where they are buried alive by the side of their eggs, so that when the larvæ are hatched out they find a fresh repast awaiting them in the form of these living but paralyzed spiders, caterpillars, etc. The "mud daubers" have the same habits, and we all know them, and how they, with pellets of mud, build their curious cells against walls and fences and in all sorts of places about our country houses. These are great species to paralyze spiders and place them in these mud cells and sealing them up afterward for the future use of their young (*Pelopœus*). When collecting in New Orleans I frequently did a good day's work in spider collecting by cracking open these mud nests. Packard also refers to those sand and mud wasps that dig deep holes in our gravel walks and have the instinct to sting grasshoppers in one of the thoracic ganglia, thus paralyzing the victim, in which the wasp lays her eggs; and the young, hatching, feed upon the living but paralyzed grasshoppers, the store of living food not being exhausted until the larval wasp is ready to stop eating and finish its transformations (*Sphex ichneumonea*).

In a paragraph above I have referred to the family *Vespidæ* of the group *Diploptera*,* and it includes some of the most inter-

* From the Greek *diplos*, doubled, and *ptera*, wings, referring to the fact that the representatives of this family, when in a state of repose, fold their fore wings longitudinally.

esting wasps and hornets of which we have any knowledge. So far as it is known to me, the *Vespidæ* are all *social species*, the individuals consisting of males, females, and neuters. They are also known as the "paper-making" wasps, having the habit of constructing paper nests of various sizes and forms in which their young are reared. Our common brown wasps (*Polistes*) are too well known to require any detailed description. To those living anywhere in the Atlantic States their paper nests are very familiar, being formed of a circular disk of a single tier of cells, being suspended at the solid back by a median pedicle attached to the point chosen by the community to build. Usually these cells face downward, but occasionally the plane of the nest is vertical or nearly so, causing the long axes of the cells to lie horizontally, or more or less obliquely. This grayish, papery stuff used by the paper-making wasps is a composition of their own manufacture. In the case of the common wasp it is made by the female (*Vespa vulgaris*), she using the fibers of old wood for the purpose. These she gnaws and kneads until they come to be of a consistence of *papier-maché* pulp—the mixture being assisted by the secretion of the salivary glands of the insect.

The paper hornet (*Vespa maculata*) builds often a very large and elaborate nest of this material. These structures are frequently found in various localities in the eastern United States and elsewhere. The year before last a colony of them built beneath the eaves of the tower to my residence in the suburban parts of Washington, D. C. A great paper nest filled the entire angle of the recess. When they build in the forests, however, these insects usually select the smaller limbs of bushes or trees, making the nest more or less spherical or ellipsoidal in contour. Sometimes these are placed high up in the trees, but again may be close to the ground. Two years ago I discovered a deserted one near my present home that was fastened to the twin trunks of a small dogwood, its lower surface being practically in contact with the ground. It was of an egg-shaped form, with the small end downward; the entire affair measuring about thirty centimetres by twenty-two centimetres, selecting for the purpose the greatest vertical diameter and the longest horizontal one (see Fig. 2). Eight distinct layers composed the walls of this nest, and its entrance, a small oval opening, was situated low down in front. It contained three tiers of unipedicled nests of cells, they being closely packed together, and the disks faced downward and were about a centimetre apart. As usual, any single cell was in contact with all its juxta-placed neighbors, and when not too closely crowded they were seen to be of a cylindrical form, but if the crowding was closer they then assumed the hexagonal shape. At their bases they were rounded, while inferiorly they were open

and exhibited the various means by which the young had escaped when the proper time had arrived for them to do so. In some cases the thin paper cap was perforated; in others it had been lifted as a cover; while, finally, in some it was practically gone altogether. Paper hornets will, as every one knows who has ever had any experience of the kind, sally forth in numbers and protect their nest by winged attacks *en masse* and in loose order, their stings being no trifling matter in many cases. I have before

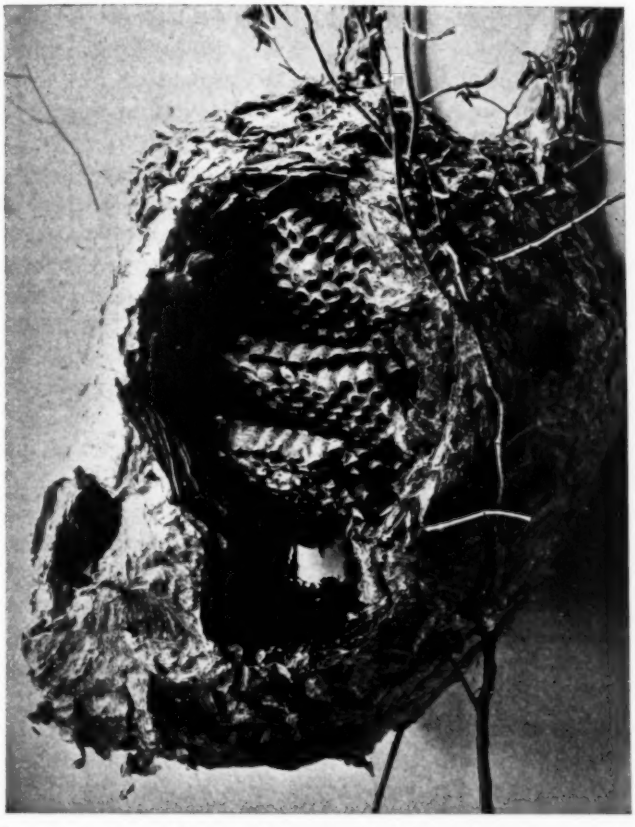


FIG. 2.—NEST OF THE PAPER HORNET (*Vespa maculata*). One side cut away to show interior. Collected and photographed by Dr. Shufeldt.

me another very pretty nest of this kind found in the same locality, but built by a different species. It is no bigger than an ordinary peg top, being attached to the twig of a blackberry vine by its large end, the apex, looking directly downward, being occupied by a single circular aperture leading to the interior. Externally this little structure is very smooth, and it contains but one small disk, composed of but seven or eight cells.

Other communities of social hornets build their vespiaries in

the hollows of trees and logs, which they occasionally clean out to render the places fit for their purposes.

Arthur Shipley, in describing some of the habits of the *Vespidæ*, has said in part that the workers among hornets "are females in which the ovary remains undeveloped; they resemble the perfect female in external appearance, but are slightly smaller. Unlike the bees', the wasps' community is annual, existing for one summer only. Most of the members die at the approach of autumn, but a few females which have been fertilized hibernate through the winter, sheltered under stones or hollow trees. In the spring and with the returning of warm weather the female regains her activity and emerges from her hiding place. She then sets about finding a convenient place for building a nest and establishing a new colony."

The methods of making the paper cells and their arrangement, the laying of the eggs in them, and the rearing of the young are practically much the same in both the common wasps and the social paper hornets. So Professor Shipley, after describing the manufacture of the paper nest of the common wasp (*Vespa vulgaris*)—how she lays a single egg at the bottom of each of the first three cells, and then this, the foundress of the society, "continues to add cells to the comb, and as soon as the grubs appear from the first-laid eggs she has in addition to tend and feed them."

"The grubs are apodal, thicker at the middle than at either end; the mandibles bear three teeth; the maxillæ and labium are represented by fleshy tubercles. The body, including the head, consists of fourteen segments, which bear lateral tubercles and spiracles. They have no arms. They are suspended with the head downward in the cells, and require a good deal of attention, being fed by their mother upon insects which are well chewed before they are given to the larvæ, or upon honey. At the same time the mother is enlarging and deepening the cells in which they live, building new cells and laying more eggs, which are usually suspended in the same angle of each cell. The development within the egg takes eight days.

"After about a fortnight the grubs cease to feed, and, forming a silky cover to their cells, become pupæ. This quiescent state lasts about ten days, at the end of which period they emerge as the imago or perfect insect. The silky covering of the cell is round or convex outward, and to leave the cell the insect either pushes it out, when it opens like a box lid, or gnaws a round hole through it. As soon as the cell is vacated it is cleaned out and another egg deposited. In this way two or three larvæ occupy successively the same cell during the summer. The first wasps that appear in a nest are neuters or workers, and these at once set to work to enlarge the comb and feed the larvæ, etc. . . .

"In a favorable season, when the weather is warm and food plentiful, a nest may contain many thousands of cells full of wasps in various stages of development, and, as each cell is occupied two or three times in the course of a summer, those authorities who put the number of the members of the community as high as thirty thousand are probably not far wrong.

"At the approach of autumn the society begins to break up; the males fertilize the females while flying high in the air; they then die, often within a few hours. The workers leave the nest, carrying with them any grubs that remain in the cells, and both soon perish. The nest is entirely deserted. The females which have been fertilized creep into crevices under stones or trees or hide among moss, and hibernate until the warmth of the following spring induces them to leave their hiding places and set about founding a new community."

Where hornets or wasps occur in very large numbers they frequently, at certain seasons, do considerable damage to fruit and forest trees by gnawing off the bark to build their paper nests. They destroy the fruit they attack, living as they do upon the juices extracted from it. But, on the other hand, these insects are very useful in that they likewise feed on flies and other insects, and so very materially diminish the numbers of these pests. Some wasps live in part upon honey, which they collect from the most open-petaled flowers, and thus to a very moderate extent they may be regarded in the light of flower fertilizers. Kirkland says, in the first volume of the American Naturalist, that "the paper hornet (*Vespa maculata*) often enters my nucleus hives, when I am rearing Italian queen bees, and captures the young queen in the midst of her little colony, usually just after she has commenced her first laying. I have seen this depredator enter the small hive, drag out the queen, and fly away with her to the woods" (page 52). Some of the species of the genus *Polistes* store up honey which is poisonous, from the fact that it has been collected from poisonous flowers. They are found in South America, where also species of the genus *Chartergus* occur—wasps that make a very remarkable and tough nest, with funnel-shaped combs inside, arranged one inside of another, nest fashion, but not in contact except at their points of suspension. At the apices of these cones occur the apertures of entrance for the inmates to pass up among the conical tiers. *Icaria*, a genus represented in Australia, the East Indies, Africa, and Madagascar, contains some very remarkable species. Some of them have the power of contracting the hinder segments of the abdomen so far within the body that at first sight they appear to have been broken off. Many of these species are very small and brilliantly colored, and often build curiously shaped little paper nests.

Wasps and hornets are not without their enemies, for their nests are frequently infested by parasitical insects that feed upon their grubs. According to Shipley, "In the tropics some species are attacked by fungi, the hyphæ of which protrude between the segments of the abdomen and give the wasp a very extraordinary appearance."

From the wasps and hornets I next pass to a consideration of a few of the species of bees, omitting, however, anything in reference to the common hive bee (*Apis mellifica*), of which insect entire volumes have been written.

Hundreds of species of wild bees are now known, and they are to be found in almost every part of the world, and doubtless many species yet remain to be described by the entomologists. Those found have been arranged in the two families *Andrenidæ* and *Apidæ* by Kirby, and are subdivided into a number of genera. In the first family all the species are solitary of habit, while in the second both solitary and social species are found. True honey-bees are found wild in this country, and the species most nearly allied to them with us is the common bumblebee (*Bombus*), of which genus upward of fifty species or more occur in North America. This bee, or rather a queen of this species, hibernates all winter, but early in the spring makes her nest. This may be under any old log or piece of turf or the vacated nest of a field mouse. A dozen eggs or so are laid in a mixture she makes of pollen and honey, and the young appear in series from egg to imago, the period of development being of no great length. From this time on the study of the colony is full of interest, but the sequence of events is not altogether unlike what has been described above for the wasps, the nature of the nest and the fate of the eggs when first deposited being the main difference.

Bumblebees are preyed upon by a variety of parasites, the most curious being a species of *Apathus*, an insect so closely resembling its host that it requires the eye of an expert to detect the one from the other. Many of us are familiar with the history of the tunnels in posts, planks, and similar places made by that large species known as the Virginian carpenter bee (*Xylocopa virginica*); and then, too, we have its pretty little ally, the bright pea-green *Ceratina dupla*, that constructs similar tunnels in such plants as have a pithy center, as reeds and elderberry bushes. These tunnels in either case are intended to hold the cells in which the eggs are deposited and the young reared. The habits of the tailor or leaf-cutting bee are even still more interesting (*Megachile centuncularis*). They have strong, sharp-cutting jaws, by means of which they cut away bits of leaves to be used in the formation of their cells, the site of the nest being in elder stalks or under planks or in the hollows of certain trees. Their very

interesting habits have been closely studied by a number of naturalists. Mason bees of the genus *Osmia* are also small and brilliantly colored, blue or green, having habits somewhat akin to those of *Megachile*. A European species is said to build her cells of mud, depositing them in the empty shells of snails. Many other species of this genus *Osmia*, in various parts of the world, possess habits full of interest to us, that have been described in the books with greater or less detail. Then we have the less intelligent types of those bees that burrow in the ground, that are solitary, and leave their young to look out for themselves. These fossorial bees see their types in such forms or species as the common *Andrena vicina*, that I have observed in many parts of New England. Parasitic bees, called cuckoo bees (as *Nomada sex-fasciata*), prey upon these fossorial forms, such as *Andrena* or its allies of the genus *Halictus* and others, by laying their eggs in their nests. They are also infested by numerous other parasites, such as by certain ichneumon flies and oil beetles (*Meloë*), and others. Some of the South American bees are destitute of stings (*Melipoma, Trigona*), and I have frequently seen a large bee here near Washington that does not sting. It has the appearance of a *Bombus*, but the fore part of the head is nearly all of a very pale yellow, almost white.

Carder bees (*Bombi muscorum*) are known to all frequenters of open fields and meadows, after the haying season has commenced. A popular writer at hand says: "They select for their nest a shallow excavation in the ground about a foot in diameter, or, if such a one is not to be found, they make one with prodigious labor. This they cover over with a dome of moss, or sometimes with withered grass. They collect their materials by pushing them along upon the ground, working backward like the tumblebugs. Frequently in the spring a single female founds a colony, and by perseverance collects the mossy covering in the way described; later in the season, when the hive is populous and can afford more hands, there is an ingenious division of this labor. A file of bees, to the number sometimes of half a dozen, is established from the nest to the moss or grass which they intend to use, the heads of all the file of bees being turned from the nest and toward the material. The last bee of the file lays hold of some of the moss with her mandibles, disentangles it from the rest, and, having *carded* it with her fore legs into a sort of felt or small bundle, she pushes it under her body to the next bee, who passes it in the same manner to the next, and so on till it is brought to the border of the nest—in the same way as we sometimes see sugar loaves conveyed from a cart to a warehouse by a file of porters throwing them from one to another. The elevation of the dome, which is all built from the interior, is from four to six inches above the

level of the field. Besides the moss or grass, they frequently employ coarse wax to form the ceiling of the vault, for the purpose of keeping out rain and preventing high winds from destroying it. Within this retreat the eggs present an appearance not very different from that of the bumblebee."

In conclusion, I may say that among the ancient Hebrews and Romans the error was widely credited that bees made their nests and reared their young in the carcasses of dead animals; and, although these people knew that bees were governed by a ruler, they labored under the impression that it was a king and not a queen. Such ignorance can easily be overlooked, however, when we come to consider that it is only of comparatively recent date that we have worked out the biology of these insects, and, as it is, there yet remains the greater part, by all odds, of their natural history of which we know little or absolutely nothing, and to which must still be added that of the host of species of this order yet to be discovered and made known to science.

THE PRINCIPLE OF ECONOMY IN EVOLUTION.

By EDMUND NOBLE.

ONE of the many interesting things about evolution, oftener taken for granted than formally recognized, is the fact that the changes which everywhere accompany and constitute it have their rise in a simple excess of pressure in one direction over the pressure in another. For all movement, whether it be of simple or of complex matter, whether it be of an inorganic or an organic system, whether it involve will and conscious perception or not, is in every case and under every conceivable set of circumstances movement in a single mode—that is to say, movement in the direction of the least resistance, or from the direction of the greatest traction or stress.* If we look to the origin of the movement, we shall speak of acting as in the line of the greatest stress; if we consider the resistances in the presence of which movement is produced, we shall regard acting as in the direction of the least resistance. But, however we may describe it, the truth of the law is obvious, since it follows from the very nature of movement. For if a body be equally stressed from all directions it will not move, while if it be stressed differentially—in one direction more than in other directions—it will move in the line of, or away from, the greatest stress. Now, as all movement must

* In order to save repetition, the word "stress" will be used throughout in the sense of traction or stress."

take place in the presence of or against resistance, a body which moves in the line of the greatest stress necessarily moves in the direction of the least stress, and it is this movement in the direction of the least stress which we mean when we speak of movement in the direction of the least resistance.

We have next to note what is meant by the greatest stress. This is not necessarily a stress applied at a single moment in time or at a single point in space. The movement of a billiard ball, for example, may be determined for part of its course wholly by the blow given with the cue, but the cushions soon come into action, and thus the total course of the ball is decided, not solely by the cue, but by the cue and all subsequent stresses of the cushions and balls that happen to be struck. In like manner, the initial impulse is given to the cannon ball by the exploding gunpowder, yet this initial stress is immediately complicated with gravitative action; and when we say that such a ball moves in the line of the greatest stress, we mean not simply the direction originally given by the cannon, but the whole direction as determined by cannon, gravity, and atmosphere. The greatest stress determining the direction of movement, then, is a stress made up, not only of the initial stress, but also of all subsequent determinations encountered as resistances by the moving body in its course; and when we say that a body moves in the direction of the least resistance, we mean that its total movement is determined by the total of greatest stresses. It is true that a distinction may be made between the original impulse given to a body and the subsequent stress or stresses entailed upon it by its own movement, and due to contact with other bodies at rest or in motion. It is an active stress, for example, which gives the initial impulse to the billiard ball; it is a reactive stress by which the cushion deflects the ball from its original course. But this distinction is little more than formal; the whole of the stresses determining movement, however easy it may be to analyze them into parts, must be regarded in their totality; for if we have to account for movements that take place in time in their totality, we must consider the determinations to those movements in their totality.

The law of least resistance, as we may briefly call it, finds exemplification alike in the realm of life and in the world of inanimate things. Not only are all movements of masses and their parts—from the descent of a bowlder down the hillside to the revolutions of planets in their orbits; from the activities of gas molecules in a chemist's laboratory to the movements of cosmical aggregation out of which suns arise—due to a differential stress producing motion in the presence of resistance to that motion: the law is valid also for the activities of animals, since, if the molecular forces embodied in an organic system impel that

system to move to particular ends in the interest of maintenance, it can not move to such ends save in the direction of the least resistance. Thus, if a stone thrown at a mark takes the shortest route, having regard to the whole of the influences which act upon it, so a pedestrian goes to his destination by the shortest way which the circumstances permit. A volume of steam finds exit from an overstrained boiler at the weakest point; so by the weakest point an animal escapes from its cage. As a river flows through its channel, determined to that path by the resistance which prevents deviation from it, so the traveler is held to the beaten track by the broken and difficult ground on each side of it. A bullet is diverted by some obstacle suddenly encountered; the root of a plant coils round the stone it meets; the railway engineer usually carries his line round an obstruction instead of through it; the secondary current of an induction coil avoids a journey of many miles by leaping through a flaw in the insulation; a dishonest pupil avoids work at examination by copying the replies of a fellow-student. The light wave makes its way, roughly speaking, spirally through ether; objects of large surface and slow descent, such as certain suitably shaped pieces of paper, descend through the atmosphere in a spiral path; a bubble of air ascends spirally through water; the plant climbs a tree by spiral windings; a horse mounting a steep ascent with a heavy load takes a zigzag or spiriform course; men ascend and descend by spiral stairways; water sinks through an orifice spirally, and the descent of a whirlpool is a spiral; boring instruments, such as gimlets, augers, corkscrews, have spiral blades. The hunter seeks particular animals at pools and watercourses which they frequent, as certain medusæ throng to water traversed by a beam of light because the illumination attracts thither small crustacea upon which they feed. Earthworms, in drawing leaves into their holes, seize the leaf at such a point as will permit its passage into the hole with the least amount of resistance; a man carrying a ladder on his shoulder through a crowded thoroughfare carefully regulates his movements so as to avoid collisions. Men escape from an invested city by utilizing the wind; the invested dandelion balloons its seed to a place where it can grow in safety. Certain organisms wear the garb of others in order to increase the ease of their existence; certain men mimic their fellows to the like end of diminishing resistance. As a mother disguises her child's medicine in sugar or sirup, so plants offer their seeds to animals in sweetly flavored fruits. Bees construct their combs in the form that secures the utmost capacity for storage with the smallest expenditure of building material and therefore of energy; so human builders attain in their constructions a maximum of needed effect with the lowest minimum expenditure of material and labor. A general

carrying on war, a statesman conducting affairs of government, a merchant engaged in business negotiations, alike take the path which, having regard to the whole of the circumstances, offers the least amount of resistance to the attainment of the ends in view.

All inorganic and organic movements are therefore alike in the fact that each is due to a greatest stress, and takes place in the direction of a least resistance. It is true, of course, that a pedestrian does not rebound, like the billiard ball, from the resistances which he encounters in trying to find the easiest path through a forest or over the mountains; yet he consciously seeks the path of least resistance, and does so because he is diverted into it by the greater resistances of all other paths; these greater resistances become part of the greatest stress which determines the form of his movement, just as the reactive stress of the cushions forms part of the greatest stress that determines the path of the billiard ball. Inorganic and organic movements differ from each other simply in the fact that by living animals the path of least resistance is more or less consciously chosen, while in the inorganic world the path of least resistance is not chosen. And this unlikeness arises out of a more fundamental unlikeness still, from the fact that movement in the realm of the organic has end for its concomitant, though not necessarily conscious end, while in the motion of things inanimate end is wholly absent. Organic movements, that is to say, are all directed to some end, while in the realm of the inorganic, movements are simply unintelligent effects, results, or products of differential stress. In the form of organic movement, end plays a most important part, while in inorganic movement it has no part at all. Thus a pedestrian may find a circuitous route through a forest the easiest if his only end be to pass through it as quickly as possible; yet, should botanizing be his object, the form of his movement will be quite different, and may very well be the direction of greatest resistance, so far as physical obstacles to movement are concerned. In the case, moreover, of particular ends, numerous opportunities for the exercise of choice present themselves. The more direct path up a mountain is chosen in preference to the one less direct, yet, when the "easier" path is the more dangerous, the traveler takes the safer and more difficult passage. So the more efficient tool is preferred to the less perfect instrument; and so, out of numberless ways in which the ends of life are to be reached, men instinctively and consciously choose those which, by encountering the least possible resistances, involve the minimum expenditure of effort. In the case of organic movements, economy of energy is possible because of the presence of end, the existence of various ways of reaching it, and the possibility of choosing the one which

involves the least expenditure of energy. In the case of inorganic movements there is no such economy, since those movements are mere effects, and comply unvaryingly with the laws of mechanics. Finally, the exertion of choice by an organism does not determine whether movement shall take place in the direction of the least resistance or not—for that is the inevitable mode of all movements, organic as well as inorganic—but whether the energy expended in the differential or greatest stress producing movement shall be a larger or a smaller quantity.

We have next to note that the economy of energy which is possible in organic movements has two forms. There is economy in the realm of the conscious will, exemplified in movements by which animals reach various ends; and there is an economy in the realm of the unconscious life of the organism by which the parts thereof rearrange themselves in such a way as to lessen the expenditure of effort in the work of maintenance. For, whenever function is imposed by the organism upon certain of its parts, such parts, moving into configurations of least resistance, set up the intelligent adaptations which we know as organs. The only difference between a tool and an organ is that the former has been consciously shaped by man, whereas the latter has arisen through the unconsciously effected rearrangements of living molecules upon which function has been imposed by the organism. All organs, like all tools, are paths of least resistance, ways of reaching ends of organic maintenance with a minimum expenditure of effort. Simultaneously, moreover, with the saving of energy spared through the gradual perfecting of organs, there goes on a gradual improvement of the ends which such organs are unconsciously produced to reach. For this is simply to say that all effort saved by an organism through increase of the efficiency of its organs and processes goes—the circumstances being favorable—to increase the complexity and delicacy of its relation to the environment, as well as to enlarge the scope of the activities of maintenance.

The way in which organic molecules move into configurations that offer the least resistance to their special activities may be seen in similar structural formations which are more or less unconsciously assumed by human beings. One of these is the habit of taking turn by people waiting, say, at the box office of a theatre—a configuration which is assumed more or less unconsciously, because it is the one which, under the whole of the circumstances, involves conditions of least resistance. There is a similar selection of conformations involving a maximum of ease in the manner in which pedestrians avoid collision with each other. The throng in movement on the crowded sideways of a great city divides itself naturally and without conscious delibera-

tion into two streams going in contrary directions, each pursuing its particular course without the slightest resistance from the other, and to the manifest advantage, both in amount of energy expended and speed of movement, of every individual concerned.

The history of social and industrial ascent is, throughout, a record of the lessening of the resistance encountered in the attainment of human ends, as well as of the constant improvement of those ends. Social ascent not only diminishes resistance within the tribe, community, or nation; it everywhere lessens external aggression, substitutes mutual aid for the antagonisms of conflict, and enables men to devote energy spent in war to the pursuits of peace. Step by step with this lessening of resistance by the reduction of conflict, there goes on within the social body, and between the group of social bodies, those co-operative movements which, by tending to unify men, gradually bring to the aid of the individual the whole power of the social organism. In the beginning there is little industrial co-operation: each man is his own agriculturist, hunter, tailor, shoemaker, and soldier—each, that is to say, discharges for himself the work which individual maintenance involves. But little by little men discover the superior ease of mutual aid, and as they learn the value of the division of labor, the function of maintenance, originally exercised almost wholly by each individual for himself, comes more and more to be distributed among sets of individuals specially differentiated for the tasks allotted to them, and finally there arise those wider interdependencies of industrial and commercial co-operation that bind the inhabitants of almost every clime under the sun in bonds of mutual indebtedness. That the whole of this movement is a movement of constantly increasing economy of energy in the reaching of special ends, and of constant ascent in the scope and perfection of those ends, will be evident when we remember that the lower we go down in the scale of human existence—to the stages where coacting is least developed—the more rudely and imperfectly are the ends of maintenance reached, and the more completely is the time of the organism exhausted in attaining them, while the higher we look in co-operation the more efficiently are those ends accomplished, and the less time is taken up in their performance.

The way in which labor is reduced and end perfected, both as to the quality of the work and the time in which it is performed, has been shown in many familiar examples of co-operative acting. The advantages of giving particular tasks to specialized sets of workmen in such processes as those of coining and pin-making is well known. The gradual improvement of tools—which are really means to the attainment of the ends of the individual and of the community of individuals, and must therefore share in the move-

ment of ascent in which those individuals are engaged—yields in its every detail an illustration of the mode of all movement. At first, tools were of the rudest kind, and men reached their ends with labor enormous compared with that needed for the attainment of the same ends to-day; but in proportion as they acquired knowledge of the external world, of the properties of things, of how things act and may be acted upon, and of the means and methods by which desired results may be brought about—in proportion, moreover, as human need, widening and becoming more varied with human ascent, made demand for a larger number and a greater variety of implements—in such proportion did men perfect, not only their tools, but also the ends possible of attainment therewith. To the implements, moreover, once used only by individuals, there have been added the tools called into service as social appliances by groups of men, and finally by the whole community. Thus the progress of tools has been an ascent, not only from the sandals of rawhide to the shoe of civilized races, from the knife of stone to the modern blade of steel, from the sticks rubbed together to the lucifer match, from the sling to the rifle, from the bone needle to the sewing machine, and from the gnomon and the clepsydra to the timepiece—it has also meant the gradual development of such social mechanisms as steamboats, railways, street cars, post offices, telegraphs, and the like. Finally, all such improvement, whether of the individual or the social appliance, has been, from first to last, progress in the economy of the labor needed for particular ends and perfection of the ends themselves.

Illustrations of the law of least resistance may also be drawn from the realm of mind. The need of economizing energy in thought is one which, however conscious or unconscious we may be of it, dominates and directs, so to speak, all our mental activities. This is suggested by the familiar antithesis between breadth and profundity of acquirements—by the fact that artistic genius is usually divorced from depth of intellect, that speculative ability is rarely associated with knowledge of the world, that the thinker who is deeply versed in general principles is almost never a specialist, that the poet is only phenomenally a man of affairs, and that the power to think originally and philosophically and the power to excel in the graces of literary style are rarely allied in one and the same individual, or present in any individual at one and the same moment. In a general way, we can concentrate the mind, so to speak, upon any particular object only by abstracting it from all other objects; our attention to a speaker, or a book, ebbs and flows according to the interest we take in particular passages; more than half the familiar activities of our daily life are performed without any attention to them which can properly be called conscious. We are constantly, on the one hand, reserving

voluntary effort for the less habitual processes and activities, and on the other committing such processes and activities, to the extent that they become habitual, to the realm of the subconscious.

What is true of our bodily activities is equally true of the mental processes through which we form judgments and reach conclusions. To men in the mass, partial aspects of reality are easier to seize than complete verities; they find "concrete facts" more comprehensible than general principles; the gently undulating slopes of belief offer them a less arduous path than that which leads over the steep cliffs of knowledge; for most of them, the rosy streamers that herald morning are more beautiful than the full lights of day:

> L'homme est de glace aux vérités—
> Il est de feu pour les mensonges!

Hence it is that in their earlier thoughts men explain the invisible parts of the external world in terms of the parts visible to them; that they confound the object with the garb woven for it by the subject; that they conceive anthropopathically of things and activities in the external world and that most of their ideas of the universe and of its parts presuppose the human organism as the source of the analogies which alone make them intelligible. There can be thus no theory of the universe, however crude, and no religious belief, however barbarous, which may not find its justification in the fact that, for a particular stage of mental ascent, it is an expression of the law of least resistance. If, moreover, the beliefs and theories of individuals and races, at first of the simplest kind, become more complex as men ascend in mental power and knowledge; and, if, as the spheres of feeling and knowing draw near to one another, each grows richer in content until in both the mind is enabled to range in a world of ideas inaccessible to man on a lower plane of development—these results are reached in every stage of the progress they constitute not only by the saving of energy through the improvement of mental operations, but also by the enlarging and perfection of the ends compassed by those operations.

The history of the concept is itself full of evidence to the same effect. In the early stage of mental development, men attach high validity to appearances, and thus form concepts which connect things only on the basis of their superficial likenesses and differences; the stage is one in which, while there are terms for the members of a class, those descriptive of the class are either very imperfect or do not exist at all—one in which, for example, there are names for particular trees, particular plants, particular animals, but no general name for tree, for plant, or for animal. Not only are objects imperfectly known in the absence of the power

to form these general concepts; it is impossible to think of them in their proper relations to one another, and thus there is at once imperfect knowledge of the external world on the one hand, and on the other, through lack of the bond of likenesses between classes, that comparative slowness of mental processes which must have been a character of all early thought. The more imperfect, in fact, are the links of likeness which binds concepts together, the more the mind tends to resemble the confusion of an unclassified library, where the needed volume can be obtained only by great expenditure of time and effort; the more complete is mental segregation, the more the mind may be said to resemble the same library properly classified. Ascent, therefore, from the knowing of things by their superficial characters to knowledge of them also in their fundamental characters enormously increases, not only the ends reached by thought, but also the ease and rapidity of mental operations.

There is another economy to be noted in mental operations—the economy wrought by the increasing content and the growing symbolism of the concept. The name first given to any object simply expresses the most prominent out of a very small number of qualities by which we know that object. In onomatopoetic words, for example, the quality perceived and named is one of sound, and the process gives rise to such terms as *kolokol*, the Russian word for "bell"; *gunguma*, the Gallas name for "drum"; *kwalalkwalal*, used for "bell" by the natives of Yakama (North America); *tumtum*, also a Gallas word, meaning "workman," or, more literally, "hammerer"; *krakra*, the name of a Dahoman watchman's rattle; *chacha*, the Aino word for "to saw"; the Peruvian *ccaccaccahay*, signifying "thunderstorm"; the Australian *bungbungween*, used for "thunder"; *hou-hou-hou-gitcha*, the Botocudo word for "to suck"; *kakakkaka*, which in Dyak means "to go on laughing loudly"; *shiriushiriukanni*, used by the Ainos in the sense of "a rasp"; and the Quichua *chiuiuiuinichi*, indicating the noise made by the wind among trees. At first, that is to say, the name means no more than the most prominent character, and perhaps the only known character, of the object to which it is applied, whether that character be one of sound, of acting, or of appearance; but, as men come to learn more of the qualities and relations of such object, the name gradually loses its descriptive value, and becomes a mere symbol or word counter for the total content of the concept. Thus, "the Russian called the duck *utka* because he saw it plunge its beak into the water; the Pole called it *kaczka*, because he noticed that it waddled in walking; the Bosnian gave it the name of *plovka*, because he saw it swimming"; yet in their survival none of these terms for the duck retain or even suggest the character which originally gave

rise to them—they imply the duck in all its characters and activities. It is for like reason that the various symbol values of a vast number of terms in our own language have gradually emerged from their original meaning as words descriptive of a single quality of the thing named—sheep from "bleater," its original meaning; dawn from "shine," pig from "grunter," or "the maker of the *su* sound," mortality from "a wasting away," mother from "fashioner," sky from "cover," mouse from "stealer," ant from "swarmer," bird from "upstriver," father from "nourisher" or "protector," ground from "the trodden," foot from "treader," woman from "bearer" (*gune*), "soft one" (*mulier*), or "the suckler" (*femina*), night from "the blind" or "dangerous," earth from "the dry" (*terra*), house from the "built," horse from "the neigher," picture from "scratching," stars from "strewn," fetters from "footers," fingers from "seizers" (*Fänger*), language from "tongue," imply from "folding in," apprehend from "taking hold of," develop from "unwrap." The gain of the process is obviously this—that the mind, instead of describing a single quality by its name—instead of having to deal with all the qualities separately—is enabled to include in a single concept all the characters which the thing named is known to possess, and to bring such concept into true relation with other concepts equally rich in the number of qualities which they connote. That the economy thus attained is no small one—that it means enlargement and perfection of end as well as saving of energy—may be realized by remembering the enormous increase which has taken place even in recent years in the meaning of such simple terms, for example, as stone and star. "Stone," to the uncultured man, is merely a hard substance of a particular color, size, shape, and weight; to the geologist the concept "stone" has a rich content of both chemical and physical characters, and demands for its thorough comprehension a familiarity with the whole history of the planet. So to the ignorant man "stars" are little more than

> specks of tinsel fixed in heaven,
> To light the midnights of his native town;

while to the educated, and above all to the scientific mind, the concept is rich with thoughts of cosmic processes and solar evolution, and has a content of materials drawn from well-nigh every department of knowledge.

Economy in language (which throughout implies economy in mental processes) is probably shown as much by that which escapes as by that which attains to expression in speech. Words are brought into use only to describe things, actions, and relations that are of habitual or frequent occurrence. A vast number of phenomena are left unnamed for the reason that they do not recur

with sufficient frequency to demand formal attention for the social purposes of language. Thus, if only one railway collision had ever occurred, the word "telescoped" would never have been invented; so a single case of "marauding" or of "boycotting" would have been totally insufficient to bring into existence these now familiar terms. It is because most emotional states are too complex ever to recur a second time in the same form and sequence that they can never become fixed by language, and that the feelings excited by the sight of a beautiful landscape, or an Alpine range, may be but imperfectly suggested only by the multitudinous epithets of a poem, and need a new poem to suggest them every time they are felt. The naming faculty is in fact called into action only as impressions emerge into familiarity: for the changing complex of the activities and relations that never recur twice in the same way, and often never recur at all, the mind has no process of classification, and therefore no concepts that can be named.

Uttered speech is full of the signs of this ever-present striving after economy. Observe the constant omission of particles and words whenever intelligibility is to be attained without them. Where gestures will suffice to convey our meaning—a beck of the hand, it may be, or a shrug of the shoulders—we do not need speech, or, when we do, a "Pooh-pooh!" a "Mind!" or a "Beware!" will often answer all our purposes. We say "in French" for "in the French language"; "Thanks!" for "I thank you"; "Herein!" for "Kommen Sie herein!" In phrases like "I go to-morrow, not you," "Ni l'or ni la grandeur ne nous rendent heureux," "Dove ci è despotismo, non ci è virtù" (Gaetano Filangieri), "Er war ärmlich, aber doch sauber gekleidet," "Me ipsum ames oportet, non mea" (Cicero), we habitually omit words formally necessary to the sentence, but not needed to convey its meaning. As, moreover, words are dropped from phrases, so letters are dropped from words. When there is no literature to stereotype a form, as in the case of the native American languages, degeneration by process of syncope sets in rapidly; it is not delayed long even for classic tongues, like Greek and Latin, or for their successors of the Romance family, on all of which phonetic decay has set its mark; while all literary tongues, ancient and modern, display the process in their colloquial forms. Thus the process which turned *anima* into *âme*, *femina* into *femme*, and *punctum* into *point*, which converted the earlier Latin *ad diem* into the later Latin of *ad die*, and in Italian shortened *de ab illo monte* into *dal monte*, has its analogue in the Bas-Valais peasant's contraction of *gênisse* into *j'ni* and *éteindre* into *tède*; in the Berlin workman's conversion of "*Ich*" into "*I*"; in the English reduction of "I love-did" to "I loved," "boatswain" to

"bos'n," "God be with you!" to "Good-by!" and in the slang which in portions of the United States has begun to dwarf "How do you do?" into "Howdy?"

There is abundant scope for economy in all the forms of literary expression. Not only do we avoid as far as possible redundant elements, we also choose words calculated to convey our meaning with the minimum of effort on the part of the reader or listener. Where our end is simply that of intelligibility, as in the case of scientific statement, we choose words as simple and as expressive as possible; where to the end of intelligibility are added the ends of style, we employ words more ornate and picturesque in their character. In most prose compositions we are satisfied if we succeed in conveying our meaning; in most poetical compositions we seek, in addition to the end of intelligibility, to produce emotional excitement, to call the imagination into powerful activity, and to give rise to various pleasing effects, such as those of rhyme and alliteration. But whatever are our ends in composition, and however multifarious they may be, we always strive to reach them in the completest way and with the least possible demand upon the attention of the persons whom we are addressing. The sparing use of metaphor and parenthesis, the placing of the stronger epithets after instead of before the weaker, the avoidance of long and involved sentences, the care taken not to repeat words already used instead of their synonyms, the provision for variety which excludes monotony both of thought and of style, the observance of a best arrangement for the words in a sentence, the choice of particular material for the various paragraphs of a composition, and the construction of the links by which unity is secured for the whole treatment—all this is ordered, as far as is possible in each individual case, so as to produce a maximum of effect with a minimum of material.

How intolerant men are of speech elements unnecessary to intelligibility is shown by the drift of the educated and uneducated alike toward a phonetic spelling by the gradual doing away with inversion in both word and sentence, and by the growing tendency to use adjectives as adverbs, to discard subtleties like the subjunctive, and break down the well-established distinction between "shall" and "will." The economy which has taken place in the domain of grammatical forms is shown both in their gradual acquirement as means to the increased intelligibility of speech, and in the haste with which the mind, no longer needing them, hastened to discard the scaffolding of the structure which with their aid it had built up. The enormous gain which has been secured by the dropping of inflection may be appreciated somewhat by reference to the clumsy paraphernalia of such undeveloped languages as Zulu, in which, as translated by Dr. Bleek,

the simple sentence, "Our great kingdom appears; we love it," must be expressed as, "The kingdom our dom, which dom is the great dom, the dom appears, we love the dom" (*U-bu-kosi b-etu o-bu-kulu bu-ya-bonakala si-bu-tanda*). So the saving attained in such a language as English may be easily inferred from the wild luxuriance in analytic distinctions of all tongues in an early stage of development.

It should be added that the gain which comes of the gradual rejection of inflection is a gain not merely in the domain of language alone, it is throughout made possible by mental ascent, and the whole of the progress which it implies is a progress not only in the saving of labor in the intercourse between men, but also in the enlargement and perfection of the ends of that intercourse.

We now return from this brief and highly incomplete account of the various forms of acting to consider the application of our principle to the case of the organic system. That principle admitted, it will be at once obvious that the law of least resistance must be true of all those rearrangements and activities which are imposed upon a living protoplasmic system in the interest of maintenance. If, in other words, such aggregate be impelled by the forces inherent in organic molecules to maintain itself, the various means by which it will maintain itself will be means such as, from the minutest detail of structural rearrangement to the highest organ and process, are best adapted under the whole of the circumstances to accomplish the end of maintenance with the minimum expenditure of energy, and this for the reason that only such means can arise by movement in the direction of the least resistance. It also follows, from the inevitableness of the law and from the character of the organic aggregate as a system of parts, that the means by which maintenance is carried on by such aggregate will undergo progressive improvement, and will therefore illustrate the same gradual advance in the economizing of energy and the perfecting of end as those which are exemplified in the ascent of the human community.

The obvious analogy between the parts of an organic system and the individuals constituting a human society is completely borne out on examination. Whether, in fact, the primitive organic aggregate be viewed as a union of previously separated units, or as an organic mass divided into unit parts that are first likes to each other and only finally differentiated, or as an aggregate that undergoes differentiation of its parts the moment it is sufficiently advanced in complexity to possess organic character, the fact remains that the parts can not constitute an organic system without aiding each other in the work of maintenance. Even if we could regard them as independent of each other, though

associated, we should be compelled to say that, acting in accordance with the law of least resistance, they would find it easier to divide that work among their own number than for each to maintain itself apart from the rest. Yet the reality is even stronger than this: since the parts are interdependent, must each act in the interest of the whole of them, and are each by that whole dominated, so to speak, into co-operation with one another for the ends of maintenance. Just in proportion, moreover, as special activities are imposed upon special parts, in that degree are such parts differentiated for the tasks they must perform; special centers and organs arise connecting the various processes with one another, until finally the whole unified system is an aggregate of co-operating but subordinated individualities, of which each is in the service of all, and all act in the interest of each—an aggregate, that is to say, in which each of the parts, instead of having to carry on itself all the activities of maintenance, obtains in exchange for its own small contribution to the general labor the services and power of the whole society. In other words, the parts of such a system, impelled to the activities of maintenance, move into those configurations in which self-maintenance is the easiest and completest for all of them, and do so by a process of gradual adaptation and interadaptation, every stage of which is a stage of increasing efficiency of end and of greater economy of energy in the reaching of that end.

The progressive unification of men in the human society also has its analogy in the progressive unification of the organic system. In the lower planes of life lack of complete solidarity between all the parts and processes of an organism often manifests itself in the well-known phenomenon of iterated organs. The system in this stage consists, so to speak, of groups or segments, and every segment has its special set of organs—such, for example, as the legs of the centiped and the lobster, the multiple breathing holes of insects, and in a variety of organisms the iterated eyes or ocelli, as well as the repeated nerve centers of many of the lower forms. As the organism becomes unified this phenomenon of iteration tends to pass away, and the change is wrought through what may be called the discovery by the organism that it is easier to produce and maintain a single set of organs of each kind for the body as a whole than to produce and maintain and use a separate set of such organs for each segment or group. Hence the ascent of the organism from the stage of iterated organs to the stage of single sets of organs, from the condition of imperfect to the condition of perfect unification, is ascent by diminution of resistance, by perfection of end, by greater economy of energy.

As, moreover, the improvement of tools is a saving of energy to the individual wielding them, so is the improvement of an

organ to the system which needs and has produced it for ends of maintenance. In the degree that the organic parts have special activities imposed upon them, in that degree do they become modified by those activities, and therefore adapted to the doing of those activities. An incipient leg, tail, fin, or eye, or any other organ, impelled to a particular thing, to act in a particular way, will do that thing more perfectly, will act in that way more completely and efficiently, with every repetition of the acting, for the reason that the parts of the organ and of the organism become with every such repetition, up to a certain natural limit, more and more adapted to the doing of that particular thing, to acting in that particular way; and this is why use is said to improve organs. The parts of such a system rearrange themselves in such a way as in every case continually to lessen the resistance offered within the system to the acting needed for each particular end. Just as from the simple foot of the snail to the leg of the vertebrates, so from the membrane of the worm sensitive to light, from the ocelli of insects and marine organisms to the highly developed eye of mammals, or from the incipient forms of internal organs to the more perfect and efficient forms of such organs, there have been progressive stages of ascent in the economy of energy with which given ends have been reached, as well as improvement of the ends themselves. In the case of organs, as in that of tools, the improvement has been made possible by a finer sense on the parts of the organism acting of the direction of least resistance, a finer self-adaptation by that organism to the environment, and a more perfect reaching of more perfect ends as the result of that adaptation.

We now see that the advantage gained by the perfection of any given organ or appliance necessary to maintenance is the advantage which, given the end to be reached, is gained by the saving of energy in the reaching of that end—that, in other words, the inducement to the improvement of any given organ is the saving of the energy spent in reaching, with the aid of that organ, the general end of maintenance. The more perfect are the appliances of the organic system, the more easily and completely does that system reach its end of maintenance; hence the gradual improvement of the organs with which maintenance is accomplished is so much movement in the direction of the least resistance. Thus the eye is gradually perfected in successive organisms, not because there is anywhere any foreknowledge that a given configuration of parts will lead to so highly useful an appliance as the organ of vision, but because, given the impulsion to maintenance and the general conditions of organic life, all structural changes leading away from the development of an organ like the eye would involve loss of energy to the organism in the reaching

of the general end, and because all rearrangements of the organic parts that lead directly to the development of the eye are favored, as against rearrangements tending in any other direction, by the fact that every successive stage of such rearrangements results in a saving of energy in the reaching of maintenance to the organism bringing them about. In a word, the path of structural movement toward the eye is the easiest path, the path of least resistance, while the path away from the eye is the most difficult path, the path of greatest resistance; and what is true of the eye is true of all other organs and organic appliances whatsoever. Given, therefore, the molecular forces which in some way not yet understood impel the organism to display those activities of maintenance which we call life, and there follow, by virtue of those forces, of the character of organic matter, and of the general conditions of existence, not only the intelligent adaptations which make possible and facilitate maintenance, but also the gradual improvement of those adaptations which constitutes organic ascent.

What, finally, is the outcome? In the biological world at the present moment the great question which interests inquirers is that of the meaning of intelligent adaptations. Thinkers in this field no longer question the existence of intelligence in the unconscious form; they seek to discover what that intelligence means. "What we should like to discover," says one of them in a letter to the writer, "is the seat of the so-called unconscious intelligence which brings about those structures which the older teleologists called designed." That natural selection supplies little if any material for an answer to the question is already recognized. It being impossible to trace these structures to an artificer operating outside, our only recourse is to look to the organism itself for the power to which the fashioning of tissues and organs is due. And though we can do nothing toward solving the fundamental problem in biology, the origin of life itself, we need not despair—given the fact of life—taking the powers of living protoplasm for granted, of comprehending something of the process by which intelligent adaptations arise. For, the rest being assumed, we see how from the operation of the law of least resistance all the mechanisms of life result by necessity. Writ minutely in the tissues of the organism the law is inscribed broadly and grandly on all the features of our modern civilization. Not an activity of the busy industrial life around us, whether it be due directly to travail of brain or hand, or find its realization in that wonderful, external side of human life—the life of machinery—but illustrates the universal mode in which all conscious intelligence reaches its end. And so also in the realm of the unconscious we have only to take for granted the powers of living protoplasm, and the simplicity as well as the exceeding beauty of the process by which

intelligent adaptations come into existence flash upon us like a revelation. We look as with vision renewed upon the pine cone in the forest, upon the flower shining amid the expanse of green, upon the sudden lightning of the firefly, and the manifold hues of insect and bird. For, little as we have attended to them before save as the commonplaces of our knowledge, we now see that they are paths of least resistance objectively embodied—protoplasmic tools with which, in the silence of the unconscious world the organic system is slowly but surely reaching its ends. And as we ponder it becomes clear to us that the same system is at work in the making of tools and the fashioning of organs—that, though the one process is conscious, the other unconscious, they are deep down in the heart of them the expressions of but a single method. Everywhere we find the evidences of this likeness—in the awl of the shoemaker and the tool of the boring insect; the earth-trap of the native African and the pitfall of the ant lion; the web of the spider and the net of the fisherman; the digging stick of the Australian, the foot of the mole, and the spade of the navvy; in the single oar of the boatman and the sculling tail of the fish; the sticky tongue of the anteater and the slime pot of the human catcher of birds; in the kayak of the savage and the floating pupa skin of the gnat; the scale armor of the armadillo and the soldier's cuirass; in the climbing hooks of the tiger beetle, the claws of the bat, and the grappling irons used in naval warfare; on the one hand, in the pulley, screw, and wedge; in chisels used in stonecutting, gravers with which wood is carved, axes for felling trees; in screwdrivers, lifting jacks, Nasmyth hammers, battering rams; the cord and weight of the window sash, the wheels of carriages, and the rollers whereon heavy masses are moved from place to place; on the other hand, in the muscles, sinews, and joints of animals; in the wing of the bird, the paddle of the porpoise, the hand of man, the mandible of the ant, the horns of the cow, the lance of the swordfish, the stinging cells of certain cœlenterata, the channeled poison tooth of the snake, or the defensive antennæ of the spider; even in the vertebrate eye itself. For all these, being objective paths of least resistance, are signs of a law that, pervading the realm of living things, has its roots in the inorganic world, since it springs from the very nature of motion as a result of differential stress. And when adequate account is taken of the presence of end in organic activities, of its absence from movements which are inorganic—account, that is to say, of the fundamental difference between living protoplasm and inorganic matter—then the whole of evolution, viewed apart from its secondary processes, may be summed up in the simple formula—movement in the direction of least resistance.

LET US THEREWITH BE CONTENT.

By ELLEN COIT ELLIOTT.

THE men of America have met the suffrage agitation with an admirable gallantry. Aspersed to their faces from the rostrum as masculine creatures of unfathomable iniquity, they return only a deprecating smile. Assured by the "new woman" that the ever feminine leadeth them on, and that politics will clarify as soon as the superior purity and integrity of the sex are brought to bear upon them, they appreciate her splendid confidence, applaud, and cry her on. There are those who, ever suspicious of the masculine character, take umbrage at this favor, looking upon it as an impertinent condescension. But surely we may grant that the slow partner of our humanity, admiring our victorious advance, and bewildered by our swift onslaughts from all points at once, wishes by his expressions of good will to placate our wrath and further our desires. Stupid and mannish he may be, but after all he is rather good-natured.

American women, however, are taking toward the question at issue a curious attitude. One large and picturesque division, when exhorted that they "ought" to desire a finger in the political pie, if not for the sake of the pie at least for the sake of the finger, show a sweet resignation, and, definitely premising that they do not wish the ballot, cry meekly that if it be the will of God to give it to them they will do their best to make a proper use of it. Others express a frank impatience with our prophets and saviors. Others, still, recognizing that the vantage ground upon which American women stand to-day is not entirely the result of democracy, give due gratitude and appreciation to those who through hard battles have helped to win the position. "But," they exclaim, "stay in your ministrations of deliverance! Forbear to impose upon us the added responsibility of the suffrage!" And, worst of all, masses of these shackled citizens show an unalterable apathy toward the injustice they are suffering, and indifference to the hands reached out to help them. Surely never did enthusiasts have to deal with more refractory and exasperating material. The suffrage leaders have proved in their own persons the angelic quality of womankind in not giving up long ago the attempt to free such inveterate slaves.

What is the significance of this general reluctance? To give her the suffrage is to add another to the long list of her opportunities for exercising power and influence outside of the home, and the question becomes, Do American women desire this, and if not, why not? The answer is bound up with the hackneyed subject of "woman's sphere," and, as all our philosophy is nowa-

days biologized, it rests back upon the great physical fact that women for all time must be prepared to bear and rear the children of the race. Granting that much of her physical disability is due to various sorts of foolishness and may be removed, it remains undeniable that in even the most normal of women the reproductive system is by nature so constituted that it requires a much larger proportion of her vitality than is the case with man. Hence, leaving out of account all other possible variations between the sexes, this difference alone is a definite handicap to all women who "compete" with men. For married women there is the further fact that childbearing and the care of children add a new and very serious handicap in any "competition" with men.

If, then, woman is physically at so great a disadvantage in many occupations, shall she not consider that these occupations are, for her, but secondary issues? For her specialty shall she not look along the line of least resistance? Instead of denying her physical constitution, shall she not exalt it by a consistent allegiance to its fundamental significance? Notwithstanding the present apotheosis of the physical sciences, woman will not rest satisfied in a purely physical explanation of her destiny. Bitter rebellion is inevitable whenever she is confronted by her physical limitations and possesses not the spiritual key to their meaning. But a spiritual significance in the life of woman has been more or less felt in all times, and in the present it is not only tacitly conceded by society in general, but it has received definite scientific formulation. From their physical constitution women more than men must inevitably sacrifice themselves for the progress of the race. Unconscious and unwilling though they may have been, necessity and habit have so trained countless generations of women in the practice of self-denial that they have grown to be in the world the special witnesses and exemplifiers of the altruistic principle. So true is it that motherhood and the love and self-sacrifice which it involves, is woman's peculiar contribution to evolution and progress, that, as has been keenly pointed out, "the woman question is not solved until it is solved by mothers." In other words, a woman can not solve her life problem on a purely individual basis except at the price of her influence on the race. A man may lead a life largely self-centered and still transmit his qualities to his children, but the self-centered woman can not pass on her qualities, for she will have no children to inherit them. If she would, in any large way, save her life, she must lose it.

The actual facts bear out this conception of a woman's function. It is not that women are wholly altruistic. Though loath to own it, we are but mortal. Nor will any (except the suffrage

leaders) contend that every woman is more unselfish than every man. On the contrary, it is only too easy to point out cases where feminine selfishness is shown again and again in petty ways to which men, as a rule, do not stoop. Yet it remains in general true that the practical life of women the world over calls for a more constant exercise of self-sacrifice than that of men, and that everywhere women have learned in the main to make their sacrifices cheerfully because lovingly, and even to court a life which brings them. That this acquiescence should be often considered an indication of tameness, if not inferiority, is but natural in a civilization which has even now only half realized the dignity of the altruistic ideal. In the affairs of life intellect has enjoyed a long prestige. Character, which, according to the highest conceptions of the race, depends at its best upon altruism, is but slowly growing into an equal recognition. In a rough, general way, men have been the apostles of the one and women of the other. It is true that the ideal of humanity is one. Women have gained in intellect and men in character, and this must go on; but it has not come about, and it will not come about, by a direct exchange of their activities.

These considerations lead to the good old dictum that "home is woman's sphere." It seems well-nigh superfluous to enumerate the obvious qualifications of this general statement. Surely no *fin-de-siècle* person would understand it to mean that woman should look upon marriage in itself as the sole desideratum of her existence, or that, failing to marry, she should devote herself to pets and fancy work, and live upon the charity of her male relatives. Surely at this stage of proceedings no one would attempt or desire to limit woman to purely domestic pursuits. It has been reiterated and most abundantly proved that she need not be circumscribed in freedom or opportunity for the sake of binding her to the home: it is not necessary, for Nature will take care of itself; and it is not expedient, for the more she is allowed to be in herself the greater the gift she can and will bring to the race. Moreover, no one will contend that every woman ought to be a mother, or that an indefinite number of offspring is a wife's chief duty. In a word, marriage, and the bearing and not bearing of children, are individual accidents dependent upon a thousand private considerations. To fulfill the law of womanhood one need not be a mother, but only to be motherly; one need not be a wife, but only to be loyal to the unselfish principle of wifehood; one need not eschew the paths of business or professional life, so only that she recognize hers as the exceptional feminine career, the more normal and significant one lying within the walls of the home.

Consciously sometimes, but perhaps more often with uncon-

scious instinct, a woman does thus stand by her colors. Why this eager activity in the matter of temperance rather than the tariff? Because intemperance menaces the home. Why this quick sympathy with organized or unorganized charities, as opposed to the average apathy over finance? Because charity touches people whom she can love and homes which she can transfigure. And—if one may be pardoned a notion somewhat transcendental—is not her oft-observed lack of creative ability, together with her equally notable power of appreciation, due to the fact that with her an idea is not worked out so readily in purely intellectual formulations as in the material of character? The laws of mechanics as such she does not readily apprehend, but the truths of rectitude which are their moral counterpart she grasps with special illumination. The masterpieces of formal art she does not create, but she, more naturally than man, can live a life which may properly be called a poem or a picture.

And why this respect for womankind deeply rooted in the best of men? The individual character of woman is not, unfortunately, so much loftier than that of man as to compel it, and that she is the "weaker sex" hardly accounts for so large a fact. Nor does it look like a merely left-over remnant of mediæval chivalry. Is it not, at bottom, that sound and sensible men recognize and reverence the altruistic ideal, which, however faltering her loyalty, it is a woman's special privilege to perpetuate? The beautiful phrase so bedraggled by controversy—

> Das Ewig-Weibliche
> Zieht uns hinan—

does it not mean that the principle of love which rules a woman's life is also the loadstar of human progress?

Homes must be made, and the masculine half of us, as they make haste to proclaim with amusing emphasis, have neither the inclination nor the ability to assume the task. Says one of them, naively, "If marriage meant to a man what it does to a woman in the way of suffering, labor, and social status, I am convinced that not one man in fifty would marry." It is impossible not to be reminded of the similar disclaimer—

> Oh, then I can't marry you, my pretty maid!

and the milkmaid's retort—

> Nobody asked you to, sir, she said—

seems singularly appropriate, did we wish to be so impolite as to use it. But, strange as it may look to the masculine mind, women in general do choose to marry. They are not driven to it by the conditions of society, nor impelled by a blind sexual instinct, nor misled by the enthusiasm of the martyr. They know

perfectly well what it will mean in their career. And they need not be looked upon as fools for so doing, being in fact possessed of the average degree of common sense of the race. They choose it because they want it, and they want it because, in spite of its restrictions, it brings the most satisfactory fulfillment of their aspirations and development of their powers.

The same masculine thinker is firmly convinced that "women wish to be men, but men do not wish to be women." Both parts of this proposition are delightfully characteristic of the sex which has never been backward in claiming its superiority, and the last clause, by the same sign, is doubtless unquestionable. But the first is as unjust to woman's ideals as it is derogatory to her mission. If she give up social pleasures, literary activity, pecuniary independence, or a hundred other personal ambitions, to minister to the interests of one modest home, and the career of one average husband; if she turn from the gratification of public recognition to years of the unapplauded cares of the nursery; if she drop out of the onward march of purely intellectual progress, and spend her life marking time in the ranks of the housekeeper—it is not because she is the poor-spirited victim of circumstances. It is not that one half the race is, by some mischance of destiny, doomed to a life of tragedy. The bird with one wing broken droops in its flight, and humanity thus hampered would have sorely lagged in its onward sweep. On the contrary, she chooses these things because law and the satisfaction of her life are not that of individual ambition or attainment, but the law of love and service—"unto the Jews a stumbling-block and unto the Greeks foolishness."

Women, it is true, do not always feel or admit this. Many of them have a taste for pity, and they pet and pity themselves and each other. Yet the more sincere own willingly that everything has its price, and that they have paid none too dear for that which they have gained by their sacrifice. The strongest scorn to pose as martyrs, because they see clearly that in life as it runs, a woman, exactly as a man, gets what she pays for, and must pay for what she gets. And they conceive of no more just equality of the sexes than this.

As to the women of America, to begin with, they are not, as some would have us think, downtrodden drudges, manacled slaves, or what not, after the same order. Rejoicing in the most perfect social freedom the world has seen, proud in a position and influence quite equal to those of men, they can afford to laugh at such tirades. With the exceptions that must always accompany general statements, woman in America may do whatever she wishes to do. She may run the typewriter in an office instead of a sewing machine at home. She may carry on a farm or a

business. She may teach, write, preach, lecture, practice law or medicine. Journalism and *belles-lettres* are her happy hunting grounds. She may marry or remain unmarried with equal honor, and no one dictates in her choice of a husband. She may wear bloomers and ride a wheel. She may carry on public agitations to an unlimited extent. The most serious drawbacks to her complete freedom result from flaws in her own standards and traditions, and are in no wise imposed upon her from without.

American men are neither tyrannical nor condescending toward women. From childhood up they have been in the habit of seeing their sisters walk beside them with independence and privilege equal to their own. Their attitude is one of frank comradery based upon a respect which on both sides is unconsciously taken for granted. They have, besides, a genial tendency to be proud of their women and to applaud rather than discourage their ambitions. If women wish to vote, these men will not deny them. In fact, many an American household presents the edifying spectacle of a husband more ready to vote the suffrage to his wife than she to accept it.

Notwithstanding this freedom—perhaps because of it—one need only obtain an unaffected expression of their feeling to find that, maid and matron alike, the women of the country are, as a rule, content in marriage as a career. They wish for children, and gladly make the prolonged sacrifices necessary to their care and education. One day a young woman—exactly such a one as may be met with any day anywhere in the country—went "in fun" to consult a fortune-teller. But she returned in tears, and confided to her girl friend that she wept because the seer had told her she would never have children.

It can not of course be said that among women there is no discontent, no restlessness. The age is full of discontent of a certain kind, and restlessness is in the blood. Women do not escape these general influences of the time. Moreover, there is, at least among college women, a special dissatisfaction with the drudgery attendant upon home-making. With the increase of individuality which the higher education can not fail to bring, comes the need of a new sort of home; and the conflict and adjustment of old with new ideals, old with new duties, old with new purposes, brings confusion and sadness into the problem of many a modern woman's life. Notwithstanding this, the college woman is found in general to be no more ready than her uneducated sister to go back upon the womanhood which means self-denial, and the career which means self-sacrifice.

When these American women, full of the complicated interests and duties of the American home and its dependent sociological activities, are confronted with the prospect of exer-

cising the suffrage, their instinct seems to be to draw back. Ask the women, one after another, in a representative community, if they wish to vote, and again and again will come the answers: "I haven't time," "My hands are overfull now," "How can I undertake a duty which means that I must inform myself upon all the public questions of the day?" Naturally, many of them, especially those who are temperance workers, or those whose property interests are not represented under existing conditions, desire the ballot. But the great majority are content to occupy themselves with the multitude of interests which are already theirs, and to leave the formal affairs of state to men. The great majority, when they speak sincerely, will say that home-making and its allied interests is their chosen life, and that its demands are so exacting that they must leave the work of government to other hands.

This attitude is certainly open to criticism. Perhaps it is true that the sons could be better educated by mothers who voted, that homes could be better made and protected by wives who held the power of the ballot, that the welfare of schools and charities would be furthered if women who are interested in them had a share in the making of the laws. Yet it would seem that if woman possessed by nature any great aptitude for political life, she would be eager to exercise it. It has been said that "the men are not what they are because they vote, but they vote because they are what they are." They make politics, and they are interested in the work of their hands. Women do not make it and (always in general) are not interested in it. If woman alone were to govern the state, how radically different would be her methods! And how can oil and water mix? Until she can disfranchise man and establish a rule of her own peculiar sort, woman may perhaps be expected to show indifference to political affairs. Furthermore, she might evince more alacrity for reaching out for the august power of the ballot if she observed that the men who exercise it thereby get what they want. But to her puzzled query, "If you want this reform or that measure, why don't you put it through?" the conclusive reply is that "you can't get at it," on account of the "primaries," or "the bosses," or "the spoils system," or the "rings," or the wheels within wheels of whatever other complications interfere to muddle the brain and thwart the will of the sovereign American people. A woman answered thus, and reflecting upon the suffrage, is apt to wonder, in her silly, feminine way, if the game is worth the candle.

Perhaps it is worth the candle. Many a wise man thinks so, and having the suffrage himself, a man should be able to estimate its value. However that question may be finally settled,

women will be women. The practical conviction that this is after all what they most wish to be must have an important bearing upon their particular aspirations, and it is this conviction which, to say the least, suggests misgivings and compels reserve in the minds of a very large number of average American women whose voices are not heard in the land.

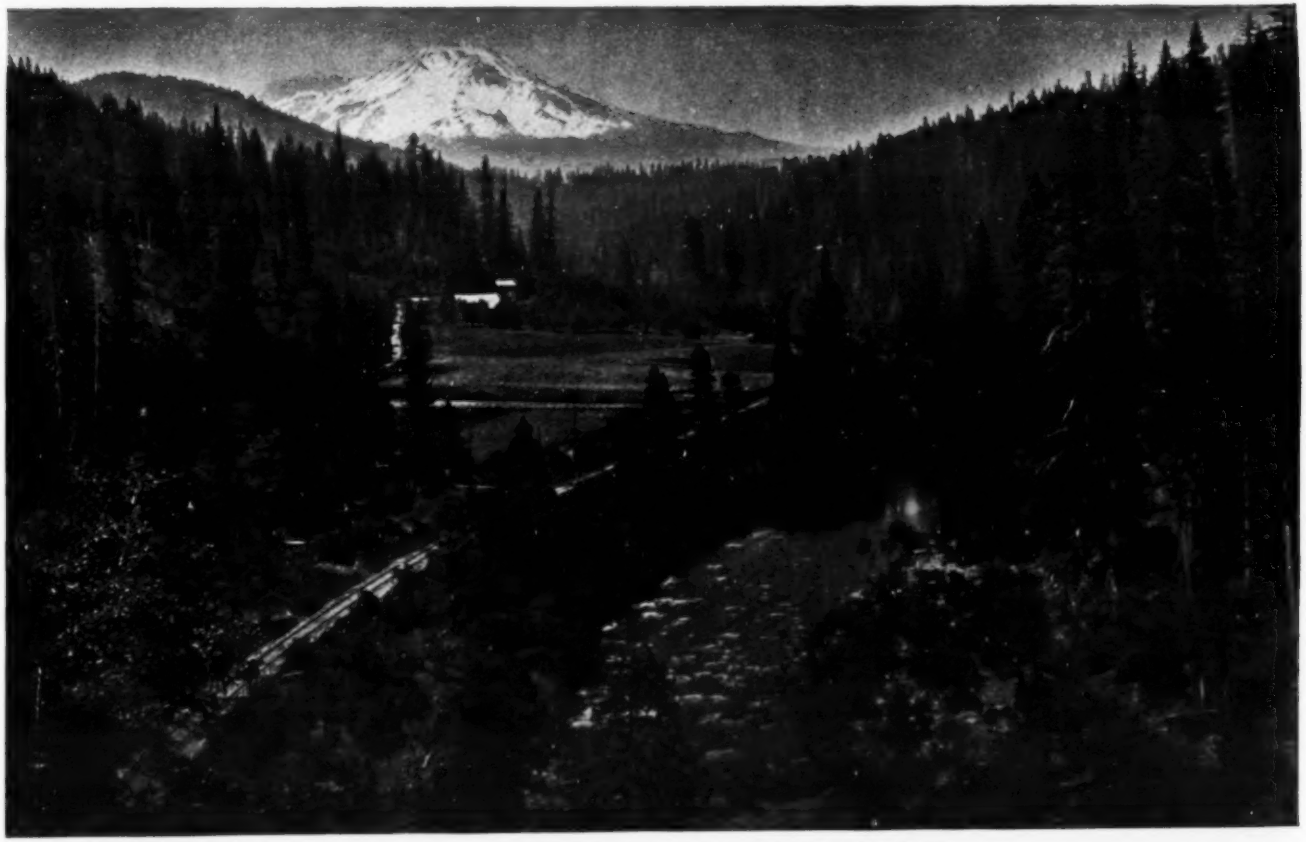
WILD FLOWERS OF THE CALIFORNIA ALPS.

By Miss B. F. HERRICK.

THE Sierra Nevada mountain range—with its lofty, snow-capped peaks and majestic glaciers, its serrated crags and romantic cañons, its foaming rivers, sparkling waterfalls, and dense pine forests—is the California Switzerland. The climate of this region more nearly resembles that of the mountains of the Atlantic coast than any other section of the far West; and the vegetation is in most respects quite similar, though there are many varieties of trees and plants that are peculiar to the State. Spring is late in these high altitudes, and the summers are of all too short duration.

Among the first flowers to greet the new year is the curious snow plant (*Sarcodes sanguinea*), world-renowned not only from the fact that it is exclusively Californian, but on account of its rare beauty and individuality. It was first discovered by one of General Fremont's exploring expeditions on the slopes inclosing the valley of the Sacramento; and is common at the Yosemite and on Mount Shasta, at an altitude of from four to nine thousand feet above the sea level. Though generally supposed to be parasitic on the roots of the pine tree, eminent botanists, after careful investigation, now claim it to be a "saprophyte," or a plant growing from a rotten substance near the surface of the soil, like certain species of fungi, an aid to this conclusion having been found in the fact that the plants are sometimes known to flourish in open places considerably removed from any growth of timber. Their usual habitat is moist, sheltered forests, where the winter snows fall deeply; and they make their appearance when the spring sun warms the frozen ground and melts the fleecy snowdrifts. True leaves they have none; and the fleshy bracts, bell-shaped blossoms, and thick, brittle stems are all of a brilliant scarlet, icy to the touch, and of the consistence of crystallized sugar. The average height is about one foot, what corresponds to the underground roots or bulbs being of about an equal depth and of a much lighter tint.

These plants are members of a suborder of the heath family;



A Glimpse of the California Alps. Mount Shasta in the distance.

though their resemblance to the sturdy manzanita, the fragrant rhododendron, or the velvet-limbed madrone is not at first apparent. They abound in gallic acid, giving them a sour smell, suggestive of ink or vinegar. In early summer the flowers are succeeded by hard, circular pods, containing numerous fine seeds like those of a poppy; and despite repeated experiments in germination, they refuse to grow in a foreign environment. Transplanting also always meets with failure, though specimens may be dried and kept for several months. A writer in Hutching's Heart of the Sierras thus graphically describes this matchless Alpine flower:

> A pyramid of tiny tongues of flame,
> Darting from out the rifts of dazzling white;
> A strange bright phantom, born of ice and fire,
> Flushing pale wastes with gleams of crimson light.

On the bleak, ice-bound heights, at an altitude of from eight to twelve thousand feet, is found the curious "red snow," a very low form of vegetable life, which, though common in polar regions, occurs in the United States only on Mount Shasta and at the head of Cross Creek, Colorado. When it is trodden upon in a half-melted state, the footsteps of the mountain-climber fill in with a clear, blood-red fluid, which leaves no stain, even if examined in the handkerchief. Some of the patches are of considerable size, while others are scarcely a foot in diameter; and the color varies from a deep magenta to the faintest shade of pink.

Rivaling the snow plant in general interest is the singular *Darlingtonia*, or California pitcher-plant, indigenous to open, marshy places in the northern part of the State from Mount Shasta to the coast, and the only species of its genus, though it is related to the Eastern *Sarracenias*, or side-saddle flowers. The pitchers, which are said to be in reality the enlarged and hollowed petioles, or leaf stalks, average about three feet in height, and are terminated by an arching hood or crest, furnished with a pair of mustachelike appendages, which are the genuine leaves. As these are provided on the under side with numerous honey glands, and are usually highly colored, they constitute the principal lure; though the cunningly devised, nodding flowers, conspicuously borne on the ends of long, bare peduncles, also contain an intoxicating nectar. The interior of the pitchers is lined with innumerable fine, downward-pointing hairs, which form a most insecure footing for the struggling victims and render escape almost an impossibility, while the glare through the lacy, dome-like roof only adds to the general confusion.

The colorless liquid which half fills the tube must be secreted by the plant itself, as the covers of the pitchers prevent the

accumulation of raindrops; and the insects ensnared are mainly winged varieties, such as flies, bees, wasps, and beetles, though ants, spiders, slugs, and other crawling creatures often share their untimely fate. In one of these omnivorous vegetable traps the writer once discovered a tuft of three straight pine needles, six inches in length, though how they ever worked their way, unbent, through the curved mouth, will ever remain an unsolved problem.

California Snow Plant.

Intermingled with the pitcher plants and coarse grasses of the swamps is often found a tall, graceful orchid (*Habenaria leucostachys*), with spikes of small, white flowers, distilling the fragrance of the tropics; and in its company frequently grows the California *Cypripedium*, or "lady's slipper," which has leafy stems about two feet in height and from three to a dozen blossoms, with brownish, twisted petals, and a white lip veined with purple.

The rose-tinted, drooping *Calypso*, and the *Spiranthes*, or "ladies' tresses," are also lovers of wet places, the latter blooming in the late summer months and being easily recognizable by the curious manner in which the little, greenish-white flowers are coiled or twisted around the stem.

Somewhat allied to the "ladies' tresses" is the "rattlesnake plantain" (*Goodyeara Menziesii*), the leaves of which were used by the Indians as sovereign cures for snake-bites. From the center of the variegated, rosettelike foliage springs a pubescent stalk, about a foot in height, bearing a spike of one-sided white flowers, which bloom in the deep woods through July and August.

The epipactus (*Epipactus gigantea*) is found in the tangled undergrowth along the banks of mountain streams, and has slender, leafy stems and from three to ten brown and green blos-

soms, marked with purple; while the *Listera*, or northern tway-blade, may be distinguished by the stout oval leaves, clasping the low stem, and the downy raceme of tiny purplish flowers.

California Pitcher Plant.

None of the above-mentioned orchids are parasitic; but there are at least two indigenous species which draw their nourishment from other plants. One is the well-known "coral root" (*Corallorrhiza*), so called on account of the fleshy rootstocks, which resemble branches of white coral. There are several varieties, inhabiting dry spots in mountain forests all over the State. Both flowers and stems are of shaded browns and yellows, and the plants readily escape detection, as they are so nearly the color of the surrounding dry weeds and grasses.

The other parasitic orchid is the *Cephalanthera Oregana*, a northern species of especial interest, suggesting the "corpse plant" or "Indian pipe" of the Eastern woods. It is wholly destitute of green leaves, and the stems and flowers are of a pure glistening white, somewhat startling in their unique beauty. Like the epipactus, it prefers the neighborhood of forest streams and hides itself in the shrubbery.

All along the banks of the foaming Sacramento there grows, as though planted by a landscape gardener, the giant saxifrage (*Saxifraga peltata*), locally known as the "umbrella plant," and also as the "Indian's rhubarb," certain portions of the plant being edible. Its generic name signifies "rock-breaker," as it is said to disintegrate the rocks from the clefts of which it springs. The graceful stalks, often a yard in length, are terminated by scalloped, circular leaves a foot or more in diameter, which resemble small parasols or umbrellas inverted by the wind. Though highly attractive in the spring and summer, they are especially ornamental in the autumn, when their clear, green tints are changed to yellows and russets. The clusters of small

pink and white blossoms, on the ends of the long, fleshy flower stalks, ripen in June into little double seed pods, which, when shaken in the hand or brushed against by accident, produce a sound much like that of the dreaded rattlesnake. Sometimes these plants domesticate themselves upon submerged rocks, the leaves floating on the surface of the current like those of a water lily, while the masses of tangled roots threaten to trip up heedless fishermen. Though many varieties of saxifrage are found in different parts of the State, none equal, either in size or picturesqueness, these beautiful border plants of the northern Sierra streams.

At irregular intervals along the banks grow tall thickets of fragrant azaleas, or rhododendrons, reflecting their bright green leaves and pink and cream-white flowers in the limpid water below; and behind them are terraces of feathery purple or white *ceanothus,* or mountain lilac, beloved by deer and honeybees.

Then come the dogwoods, flaunting their showy white bracts full fifteen feet in air, and mingling their spreading boughs with those of the laurel, the alder, the cottonwood, the wild hawthorn, and syringa. At their feet appear the freckled faces of the

GIANT SAXIFRAGE OF SACRAMENTO RIVER.

tawny tiger-lilies, the largest of which is the Humboldt, as tall as a good-sized man and with from four to six whorls of leaves, each whorl ten to twenty leaves in number; and rivaling them in attractiveness are the stately Washington lilies, with their satiny-white chalices, flecked with black and gold, suggestive of the Bermuda or Easter lilies of gardens and greenhouses.

Among other lovers of moist localities are the *Aralia*, or wild sarsaparilla (the long, aromatic roots of which are sometimes used as a substitute for the genuine commercial article), and the poisonous *Cicuta*, or water hemlock, a member of the parsley family, easily distinguished by its lofty, hollow stem, large tripennate leaves, and umbels of numerous rays of small white flowers. On the borders of Lake Tahoe flourish the beautiful pond lilies, prized by boat-riders as trophies of summer excursions; the white *Brasenias*, or "water shields"; and the sulphur-yellow *Nuphars*, or "spatterdocks," the large flat leaves of which are the favorite camping ground for small green frogs. Most of the forest underbrush is composed of the manzanita, or "little apple" (*Arctostaphylos*), sometimes known as the "bear-berry," as Bruin feasts on the fruits. This shrub averages about five feet in height and has round, thick leaves and tiny white or rose-colored blossoms which ripen in early autumn into dull-red, globular berries, resembling Indian beads. The smooth, mahogany-hued bark peels annually, like that of the madrone; and the larger boughs furnish a hard cabinet wood capable of a fine polish.

Other flowering shrubs include the heathlike bryanthus; the *Audiberta*, or white sage; the rabbit brush, and the Oregon grape or holly-leaved barberry (*Berberis*), a low bush with prickly, polished foliage and racemes of yellow flowers, succeeded by round blue berries much like those of the elder. In great patches under the pines grow the *Chamobatia* (a little evergreen plant about a foot in height with blossoms like those of the strawberry), and the trailing *Vaccinium*, or "squaw's carpet," recognized by its small, serrated leaves, and round, pale-pink bells, or hard, reddish seed vessels. The Alpine phlox clings to the rocks in high altitudes, together with the arctic willow and dwarf conifers, while the juniper redeems barren, sandy sections from utter desolation.

Two pretty little wood plants, nestling in the dry leaves under the trees, are the *Pyrola*, or "shin-leaf," and the pipsissewa, or "prince's pine" (*Chimaphila*), the former having radical variegated leaves and nodding white flowers, suggesting those of the lily of the valley, and the latter being known by its shining evergreen foliage and terminal clusters of waxy, flesh-tinted blossoms of delicate fragrance.

Near by usually grow the quaint little "Dutchman's breeches," with their fine compound leaves and drooping, pink corollas, as well as the *Asarum*, or wild ginger, so called on account of the rootstock, which has a pungent flavor. This is an odd-looking herb, with several heart-shaped leaves, and a curious, brownish-purple flower, about the size of a large thimble, which makes its appearance just above the surface of the ground, and has no petals, but a three-parted calyx.

In open, rocky places one is apt to come across the downy, pink and white "pussy's paws" (*Spraguea umbellata*), together with clumps of gorgeous lupines—lilac, yellow, or rose-color—and patches of golden coreopsis, purple pentstemons, and lovely gilias, godetias, and Indian pinks; while tall columbines, larkspurs, and wild roses peep from the tangled shrubbery. The beautiful Mariposa lily, or "butterfly tulip," a member of the calochortus family, derives its name from the large dark spots on the petals and through June delights the eye with its yellow, violet, or snow-white chalices.

AZALEAS.

In the early spring the wild flowers run riot everywhere, carpeting sunny, open spots with a veritable crazy quilt of bloom, chief among them being the large, purple-spotted *Nemophila*, or "baby-eyes," the white forget-me-not, the blue, white, and yellow violets, the wild agapanthus, the yellow iris, the wild strawberry blossom, and the far-famed *Eschscholtzia*, or California poppy, the emblem of the State. In these mountains there are a good many varieties of old-fashioned herbs, which have been used medicinally for ages, and are sacred to the memories of the spicy garrets of New England country farms. The chamomile and the aromatic peppermint and pennyroyal head the list; then come the aconite, or monk'shood, the flannely-leaved mullein, useful for lung troubles of man or beast, the woodsy yarrow, the yellow tansy, the wintergreen, and the *Brunella*, or self-heal—a cure for quinsy and all sorts of wounds.

On the outskirts of the Mount Shasta meadows, where the plowman stands knee deep in rolling billows of red clover, timothy, and redtop, there grows a singular floral torch, known as the California veratrum. This plant is a member of the lily family,

and resembles the yucca or Spanish bayonet of the southern counties, the small, greenish-white flowers being borne in a dense panicle on the summit of a stout stem, from three to seven feet in height. The long, narrow leaves are smooth and grasslike, and are suggestive of corn or sugar cane. Close at hand, the spirea, or steeple-bush, waves high in air its feathery white or

WASHINGTON LILIES.

magenta plumes; and beyond are thickets of wild plums and hazelnuts, mingled with low bushes of thimbleberries, huckleberries, and large, prickly gooseberries.

There are a number of roadside and pasture plants, known by farmers as "weeds," which nevertheless seem to have imbibed the very spirit of midsummer. Among them are included the dainty evening primose (*Enothera biennis*); the clematis, or "virgin's bower," festooning itself gracefully from tree to tree, with the wild grape and ivy; the milkweed (*Asclepias*), with its dull-pink flowers and big, oval seed pods, filled with brown seeds and silky white down; the yellow sunflower; the flame-colored *Castelleia*, or "Indian's paint brush"; the golden-rod, three to six

feet in height; the aster, dandelion, and the bright-eyed little *Hypericum*, or "Saint John's-wort," formerly used in certain parts of Europe as a charm against evil spirits. In sandy places, on the edge of the woods, grows the curious "horsetail," or telescope reed, sometimes known as "file-grass," as the rough, furrowed stalks were once used for polishing purposes. Being without true or visible blossoms, this plant belongs with the ferns, mosses, and other cryptogams, and is said to have deteriorated from the coal ages.

Toward the end of September a change creeps over the face of Nature, and a solemn hush heralds the approach of autumn. The great, towering yew tree clothes itself with scarlet berries, and the dry, yellow leaves of the maple flutter downward through the quiet air, the chokecherry dons a robe of scarlet, and ripens clusters of astringent fruit of an equally vivid hue; the deciduous azaleas drop their foliage into the sparkling river, and the dogwood and poison oak assume a garb of solferino, while the continual dropping of pine cones breaks the silence of the mountain forest. Then the snow falls like a fleecy blanket, and winter sets in, with its rigors of ice and sleet.

THE PLANET SATURN.

By CLIFTON A. HOWES, S. B.

DOUBTLESS many observers of the sky are familiar with the planet Saturn as he slowly moves through the constellations from year to year, but how many of them stop to think of the wonders and mysteries connected with this far-off member of the solar system? Very few, probably; and yet this planet is well worth a closer acquaintance, for, as Prof. Langley says, "In all the heavens there is no more wonderful object than the planet Saturn, for it preserves to us an apparent type of the plan on which all the worlds were originally made."

Saturn was the remotest planet known to the ancients, and it was probably on account of his sluggish motion along the sky that a malignant influence over human affairs was attributed to him by the astrologers. This slow movement is only apparent, however, for he is really bowling along through space more than twenty thousand miles every hour; but such is his distance from us that we can scarcely detect any change of position from night to night, and must wait thirty years for him to make his circuit of the heavens.

In point of size Saturn stands next to Jupiter, the "giant of the solar system," and upon his diameter nine earths could be

strung like beads on a wire, while from his vast bulk seven hundred planets like ours could be formed. But just here comes a factor which has an important bearing upon the present condition of Saturn. In spite of his enormous bulk, he "weighs" only ninety times as much as the earth, which at once shows us that the materials of which he is formed are much lighter than those composing our world. In fact they are but three quarters the weight of an equal amount of water, so that theoretically, if placed in an ocean large enough to hold it, this huge planet would *float* on the surface like a wooden ball.

There is but one conclusion from this and also from some other facts connected with the planet. Saturn is not, like the earth, a solid sphere covered with oceans and continents capable of supporting animal and vegetable life, but is midway between this state and that of the sun. In other words he might be called a *semi-sun*, perhaps giving forth but little light, yet so intensely heated still that its vast bulk is probably but a distended mass of liquid fire—a world where "the solid land as yet is not, and the foot could find no resting place." It is too bad to destroy the pleasant theories we often see about the inhabitants of this far-off world and the conditions of life upon its surface, but we can not evade the facts as they open up to us.

When viewed through a good telescope the planet presents a most beautiful sight—a huge golden ball, crossed by parallel belts of a brownish tinge, and capped at the poles with a bluish or greenish gray; and, most wonderful of all, surrounded by a thin, broad, flat ring, likewise of a golden hue. As if this were not enough, it is accompanied by a retinue of at least eight satellites or moons, some of which will be in the field of view.

Under very favorable conditions faint markings can be discerned on the belts, which seem in every way similar to those of Jupiter, and like his may safely be assumed to be masses of rolling clouds ranged in belts parallel to the equator by currents analogous to our trade winds. It seems very probable that these clouds may be mostly aqueous, and we may thus regard them as the future oceans of these planets, suspended in the air at present because the surface is not yet sufficiently cool to allow them to settle and remain as bodies of water upon it.

That this must be the case is shown by a moment's thought. We know that on the earth clouds are formed by the condensation, in the upper and cooler portions of the air, of the water vapor raised from the surface waters by the sun's heat. But at Saturn, nearly ten times farther away, this heat is reduced to one one-hundredth of its intensity here. On the earth too, as a rule, the clouds are somewhat sparsely distributed, so that a large part of the globe has usually fairly clear weather. On Saturn, how-

ever, we never yet have caught a glimpse, so far as known, of the real surface, whatever that surface may be. The rolling cloud masses completely envelop the planet and shut it out entirely from the sun's light.

We can scarcely suppose, then, that these clouds are raised upon this distant world by the solar heat, especially when we see how feeble that heat is compared with what the earth receives. And this is but another argument to prove the theory of Saturn's present condition as already given, for it is most probable that the planet holds in its own vast bulk the immense amount of heat whose presence is so certainly revealed in these phenomena.

Of course the rings are the unique and most wonderful feature of the whole system. When Galileo first turned his rude telescope upon Saturn, in 1610, he announced that the planet was *triple*, the projection of the ring on either side making it appear to him as if two smaller planets were joined to the larger one. Gradually, however, these smaller companions decreased in size and finally vanished altogether, much to Galileo's amazement. Later on they reappeared and still further increased his perplexity.

Saturn thus remained an enigma to astronomers until an increase in the power of telescopes brought out the fact that it was surrounded by a thin, flat ring, which, by its varying positions as seen from the earth, caused the peculiar appearances that so puzzled Galileo.

This so-called ring, when seen through large telescopes, appears as a very thin, flat disk with a circular opening in the center in which the planet itself is situated. It lies exactly in the plane of Saturn's equator, and extends considerably more than half the planet's diameter on either side of it. The breadth of the ring is just half the planet's diameter, so that there is quite a space left between its inner edge and the surface of the planet.

We speak of it as a ring, but in reality there are many of them. When favorably situated, a dark division can easily be detected which separates it into an "outer" and an "inner" bright ring; while within the last fifty years a third one, inside of the others, was discovered at Cambridge. This innermost of all, known as the "dark" or "*crêpe*" ring, is a most peculiar object. In appearance it is more like a shadow than anything else, for it seems to be semi-transparent, inasmuch as the outline of the planet can be seen *through* it where it crosses the planet's disk. It shades away gradually from the inner edge of the inner bright ring, and becomes fainter until it disappears at some nine thousand miles from the planet's surface.

What the nature of these rings may be is still in some degree a mystery. They are not gaseous, and it has been shown that

they are not liquid, for no liquid could be suspended in such a manner without being precipitated eventually upon the surface of the planet. Nor are they solid; for it has been demonstrated that no solid could hold together under such strains, such tremendous forces, as the attraction of the monster planet would subject it to; it would soon be broken up entirely.

The only supposition remaining is that it is composed of myriads of solid particles—a ring of dust and fragments of rock and stone. In this case we may imagine it as being an immense swarm of tiny moons or satellites, each revolving in its own particular path around the planet, and the aggregation presenting to us at this distance the appearance of a solid mass. Of course, the word "tiny" must be taken in an astronomical sense, which would not preclude one of these "dust" particles or fragments from being as large as a house, or even a mountain.

That the ring is composed of solid matter of some kind is proved by the fact that it reflects the sunlight which it receives, apparently unchanged in quality, and deprives of sunlight those portions of the planet on which its shadow falls. But here comes the question, If we know the ring is composed of solid matter, how do we know that it is in the form of dust and fragments? This question was long a stumbling-block, but, as Prof. George Darwin points out, the investigations of M. Roche, a French mathematician, seem to have solved the difficulty.

Briefly, the reasoning is as follows: We know that our moon always keeps the same face toward the earth, but perhaps it is not so generally known that the cause of this is in the moon's own shape, which is that of an egg with the longer diameter pointing toward the earth. Not that this egg shape is so very pronounced, but it is sufficient to keep the moon from rotating as the earth does, and to keep its longer diameter pointed toward the seat of that force which holds our satellite in its path.

The cause of this egg shape is simply in what is termed the "tide-generating force." The moon's effect upon the earth due to this force is rendered noticeable and well known in our tides. The earth also exerts the same force upon the moon, only, as the former is eighty times more massive, the effect is correspondingly greater, and the moon's globe has suffered under the strain —has been pulled out of shape, so to speak.

Now this force of course increases as its source is approached, and were the moon brought nearer and nearer the earth, a point might finally be reached where the solid materials of which she is composed could no longer hold together, and her globe would be torn to pieces by the tremendous forces to which she would be subjected. To determine this point was the problem which M. Roche solved, and his conclusions led him to place it at a

distance just under a diameter and a quarter from the planet's center. Within this distance, then, no satellite of any considerable size can circulate for the reasons above stated.

Now, the most remarkable fact remaining is that the outer edge of Saturn's ring system *lies just within this limit*, so that the conclusion as to its nature seems to point to the "meteoric theory," as it is called, as the only possible one. Either a satellite has been drawn within the fatal circle and disrupted, or the materials now present as a ring have been prevented from uniting to form a single satellite, as they might otherwise have done.

So much, then, for theory. The next point is, What proof can we get to substantiate it? This might seem at first a hopeless task, but that wonderful instrument, the spectroscope, has recently given us direct testimony on the subject.

One of the peculiarities of the spectroscope is its ability to detect the motion of a luminous body in the line of sight, by the shifting of the dark (Fraunhofer) lines of its spectrum from their normal position as seen in the spectrum of direct sunlight. Advantage was taken of this fact by Mr. J. E. Keeler, who obtained photographs of the spectrum of Saturn and its rings which plainly showed that the shifting of the lines due to the motion of the rings was greater in each case for the inner edge than for the outer, proving conclusively that the portions of the ring nearer the planet move faster than those farther away.

Let us see what this means. In the first place, if we suppose the rings to be solid, it is evident that they must rotate as a whole, the angular velocity of all parts being the same, but the linear or actual velocity being much greater at the outer edge of the ring than the inner, because of the greater circumference of the circle traveled over in rotation.

If, on the other hand, the ring is composed of separate particles, each in effect a little moon, it is apparent that the nearer these tiny satellites are to the planet the faster they must revolve to overcome the increasing pull of the planet and save themselves from being drawn to destruction upon its surface. In this case, therefore, the inner edge of the ring will have a much greater velocity than the outer.

Thus we see that the two theories require opposite conditions to obtain, and that the proof given by the spectroscope confirms directly the approximate correctness of the "meteoric theory."

This latter theory offers a ready explanation for the curious "*crêpe*" ring. Shading off gradually as this ring does from the inner edge of the bright one, it is natural to suppose that it is a portion of the former ring in which the fragments or "meteorites" are more sparsely distributed, their numbers growing gradually

less as the distance from the main ring increases, until the eye can no longer detect their mass and the ring apparently ends.

This explains why the outline of the planet can be seen through the dark ring; but if this fact is not enough, an observation made on November 1, 1889, at the Lick Observatory will further confirm the theory. This observation was of the outer satellite, which was in such a position behind the planet as to pass through the shadow of the rings and be eclipsed by it. Watching the satellite, then, as it left the planet's shadow and slowly passed on into the shadow of the rings, its light was seen to grow gradually fainter as it passed through the shadow of the dark ring, but did not wholly disappear until the moon had entered the shadow of the inner bright ring. This shows clearly that the dark ring is partially transparent, but becomes more opaque as the bright ring is approached.

With regard to the satellites there is little to be said. There are eight known at present, and there may be more, for they are mostly quite small, as heavenly bodies go. Still, they form the most numerous as well as the most extended family within the sun's domain, for the outer one of all swings around Saturn at a distance of two and a quarter millions of miles—ten times as far away as our own moon. This one, which is named Japetus, is just about the size of the moon, and apparently shares the latter's peculiar trait of always keeping one side toward its ruling planet. This supposition is due to the fact that when on the western side of Saturn Japetus is always very much brighter than when to the eastward; in fact, though easily seen with a telescope of moderate power when brightest, it will almost entirely disappear when faintest. It is difficult to explain the cause of such a marked change, for one half of the satellite must be extremely bright and the other half very much darker to produce it, but the fact remains.

Titan, as its name implies, is the largest of the group, and in size is midway between Mars and Mercury—in fact, it would make a very respectable planet itself, for it is nearly half the diameter of the earth. The other six are all considerably smaller than our moon, and have been discovered in the order of their brightness, their discovery keeping pace with the increase in the power of telescopes, so it is quite possible that there may be others in this already numerous family to be introduced later on.

We spoke in the beginning of this article of destroying the theories often put forth concerning the inhabitants and conditions of life upon this far-off world. There are certain facts and deductions, however, from which we can gain an idea of some of the conditions which may prevail when Saturn has finally reached a stage where life will be possible upon its sur-

face, and it may not be uninteresting to consider some of their peculiarities.

In considering the climatic conditions of a planet we find they depend principally upon three factors: the distance of the planet from the sun, the inclination of its axis, and the length of its year, with incidentally the length of its day. What the results of this combination may lead us to expect in the case of Saturn we will point out by using the earth, naturally, for analogy or contrast.

In the first place, as affecting animal and vegetable life, the greater distance of the sun, and the corresponding decrease in its lighting and heating power compared with the same effects on the earth, would materially change in itself the character of such life on Saturn. As already noted, the heat and light are reduced to nearly one one-hundredth of their intensity here, but no one can tell what compensating features may ultimately be provided for retaining the internal heat of the globe or storing up the sun's heat. As an instance of such adaptation we have only to turn to the planet Mars, where we have visual proof, in the melting of its polar "snows," of a much milder climate than the earth possesses, although the intensity of the sun's heat there is reduced by half.

In connection with the foregoing is the question of the composition of the atmosphere, and whether it could support such organisms as we are familiar with in terrestrial life. The spectroscope has told us but little about Saturn's atmosphere, but it is known that the planet is provided with one of considerable extent, and apparently of a similar constitution to our own. The presence of water vapor has been detected, according to some observers, but not positively; yet it is fair to suppose from other considerations that this most necessary adjunct of all life is plentifully supplied.

The change in the seasons will, of course, depend upon the inclination of the axis, which in Saturn's case is twenty-six and a half degrees from the perpendicular to its orbit. When we remember that the corresponding inclination of the earth's axis is twenty-three and a half degrees, it will be apparent that the change of seasons would be quite similar to ours, the sun merely rising three degrees higher in the heavens at the summer solstice and three degrees lower at the winter solstice. But the length of the seasons, determined by Saturn's long journey around the sun, will be, on the average, nearly seven and a half years, a fact which would render unlikely much similarity in organic life to the forms found on the earth. If we add to this the rapid succession of day and night, each being at the equator of but five and a quarter hours' duration, we may look for still further dis-

similarity; but the greatest difficulty comes when we consider the effect of the rings.

At first thought it might seem that the rings would have little to do with the climate of the planet, and in fact such is the case during the summer of either hemisphere; but winter tells a different tale, as we shall see. Since the rings lie exactly in the plane of the planet's equator, they will be presented edgewise to the sun at the equinoxes, when the sun is "vertical over the equator." At this time their shadow, part of which must fall on the planet, will lie directly on the equator, and presumably be about as wide as the general thickness of the ring system, which is estimated to be not more than one hundred miles.

As the sun travels northward from the equinox, it is apparent that the shadow will fall farther and farther south of the equator until it has covered the whole southern hemisphere, save a portion of the torrid zone where the light comes through the space between the rings and the planet. After the summer solstice the effects are reversed: the shadow retreats toward the equator, and after the succeeding equinox the southern hemisphere will have its summer undisturbed, and the northern hemisphere in turn will have its long winter made still more dreary by this remarkable daily eclipse of the sun. It thus appears that only in a relatively narrow belt lying on either side of the equator would be likely to occur climatic conditions approaching those with which we are familiar.

One often sees in articles on astronomy some reference to the grandeur of the Saturnian heavens at night, where, in addition to the starry host familiar to us all, would be the wonderful ring spanning the sky as an arch of golden light, and eight moons in their various phases. In a measure this is true, but it depends upon circumstances. During the summer half of the year in either hemisphere the illuminated side of the rings is, of course, visible—perhaps even faintly so in the daytime, as is the case with our moon; but when the twilight falls and the golden arch shines forth in all its beauty against the darkness of the sky, it must certainly be a sight which for grandeur surpasses any celestial phenomenon known to us, save possibly a total eclipse of the sun.

As soon as the sun has set, however, the shadow of the planet, where it falls upon the rings, rises in the east and mars the beauty of the arch as it travels across it during the short night and disappears in the west at sunrise. At the summer solstice, though, the sun rises high enough in the heavens, or, more correctly, the planet's axis is inclined far enough toward the sun to bring the outer ring clear of the shadow, which then appears somewhat conical in shape and reaches across the inner bright ring nearly to the outer one.

But after the autumnal equinox and during the winter season all this is changed. Not only do the rings cause daily eclipses of the sun, but they give no illumination at night, for their dark side is then toward the observer, and they can be only "negatively visible," so to speak—that is, their position in the sky is shown merely by the absence of stars in that portion.

As to their appearance from various positions on the planet, it might be said that the whole system is visible above the horizon as far as latitude 41°—that of New York and Constantinople in our northern hemisphere, and Tasmania and New Zealand in the southern. At this latitude the inner edge of the dark ring will be upon the south point of the horizon, and the arch will extend about a third of the way toward the zenith. When latitude 51° is reached, that of Dresden and Winnipeg, Manitoba, the dark ring will have sunk below the horizon, but the whole width of the bright rings will be above it; and, finally, at latitude 66° 30′, that of our Arctic and Antarctic Circles, the entire system will have disappeared.

Of the illumination given by the moons in the absence of the rings we must say a little, since one often sees some statement to the effect that so many moons must compensate in some measure for the diminution of sunlight. But as the moons are illuminated by this very sunlight, their brilliancy is reduced in the same ratio, and in Saturn's case their total light in no wise makes up for this loss.

Reckoning from the best estimates of their sizes, we find that the total area on the sky covered by the moons when full is about two and a half times the area of our own moon, but their illumination, could they all be full at once, would be only the fortieth part of what we are accustomed to at the full. Then, again, as all of them except Japetus, the outer one, lie in the plane of the equator, it is evident that at the equinoxes, when this plane passes through the sun, they will all suffer total eclipse at the full, and will continue thus until the increasing inclination of the axis toward the sun brings their orbits one by one outside the shadow at this point. Thus we see that this numerous retinue does not amount to so much, after all, in the matter of illumination.

One other feature, and one which would doubtless be noticed first of all were any of us suddenly transferred to another planet, would be our change in weight due to the change in surface gravity. If we take the dimensions of Saturn as revealed by the telescope to represent its true size, we should find much less difference than one would expect, considering the tremendous size of the planet. The combination of three factors—the much greater distance of the surface from the center of the planet,

which is the center of the attraction we call gravity; the much greater "lightness" of the materials composing the planet; and the great centrifugal or "throwing-off" force at the equator, due to the rapid rotation, and which would, of course, counteract to some extent the downward pull of gravity—results in making but a slight increase, so that a man weighing one hundred and fifty pounds on the earth would weigh only about six pounds more at Saturn's equator. At the poles, however, the change is more marked, since there is no centrifugal force, and the polar flattening, due to the rapid rotation and consequent bulging at the equator, brings one nearer the center of the planet. In this case the increase would be about thirty-six pounds, and would probably be found somewhat uncomfortable to us.

However, it is by no means certain that the dimensions seen through the telescope are the right ones to consider in this manner. If all we have ever seen of the planet is the outer side of its cloud envelope, it may be that the true surface, provided there is one at all, is far beneath the tops of these rolling cloud masses; and if there is no real surface yet—if the terrible struggle of fire and water for the mastery is still in full sway—no one can tell just what the size of the globe may be when the crust finally forms and the real planetary life begins. This "distended mass of liquid fire" may have shrunk perceptibly by that time.

This also brings up one other interesting query. The spectroscope has proved that the sun and stars are composed of materials with which we are familiar in our laboratories, and Saturn as well as the other planets must be composed of the same chemical elements, though probably with wide variations in combination and distribution. If, then, Saturn were to approach the earth in the density of its composition when it reaches a corresponding stage in its planetary growth, it must shrink to *one eighth* its present volume, or one half its present diameter. On the other hand, if its size remains anywhere near the present dimensions, we shall almost be forced to the conclusion that this great globe may eventually become one vast ocean—a dreary expanse of water with perhaps only a relatively small solid center, thousands of miles below the surface.

But whatever its future, it will always remain a most interesting object of study, and no one can consider it thoroughly without being inclined to agree with Richard Proctor, that here certainly must be a world "altogether more important in the scheme of creation than the globe on which we live."

NORTH AND SOUTH.

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A WRITER has somewhere remarked upon the different atmosphere that surrounds two well-known railway stations in the city of Baltimore. The Union Station, in the upper and newer section of the city, has about it all the life and bustle of a Northern railroad center, while at the Camden Station, for so many years the terminus of a Southern trunk line, there is an air of easy-going uncertainty that breathes of the South. If this difference in the influence of the Northern and the Southern life is felt within the narrow limits of a metropolis, it is still more apparent in the region that lies between the "City of Monuments" and its more northern neighbor. As a matter of fact, the frontier of the South extends some distance north of the region with which we are accustomed to associate it, and the real line of demarcation is a natural boundary fixed by certain well-marked geographical features and indicated by the distribution of certain animals and plants. When Mason and Dixon ran their celebrated "line," they did more than settle the dispute of a boundary between colonial Commonwealths. Their arbitrary survey embodied, in an approximate way, a more or less natural division between the people of two great physical areas, each one of which is broadly defined as a distinct geographical and political unit—the North and the South. Each of these domains is characterized by certain marked peculiarities, both in natural productions and in the life of the people, which have their origin in climatic and topographical features. Through nearly two and a half centuries the physical environment has slowly worked its subtle influence into the blood and tissues of the inhabitants in each contrasted area, producing a certain cast of thought, speech, and action which are highly characteristic and which present unmistakable marks of difference.

The Northern and the Southern seaboard States of the Atlantic slope are decidedly different in their physical aspects as a result of topography. The numerous mountain ranges embraced in the Appalachian highland have a long, southwesterly trend from New England to Alabama. In the former section, north and east of the lower Hudson Valley, the eastern slopes of the mountainous highland reach to the sea, forming the bold and rocky coast line of New England. South of the Hudson the mountain ranges become more nearly parallel; and the long chains of the Blue Ridge and the Alleghanies, trending more and more toward the southwest, stand some distance inland, leaving a

gently sloping lowland between them and the ocean—*the Atlantic coast plain.*

The coast plain is first found as a narrow strip in New Jersey. A line drawn from about the locality of Long Branch diagonally across the State to the Delaware River, at a point some distance below Philadelphia, serves roughly to indicate its inland boundary, marking it off from the upland terraces that form the foot of the highland slope. The line of demarcation then runs more and more inland, cutting off a small section of southeastern Pennsylvania, and, proceeding across the upper streams and estuaries of Chesapeake Bay, passes along the edge of the mountainous regions of Maryland and Virginia and the upland slopes of the Piedmont lands in North Carolina.

The traveler who journeys southward through William Penn's "low counties" finds himself on this line of demarcation between "the North" and "the South." Philadelphia, the last of the "Northern cities," lies behind him, and when Baltimore is reached the traveler begins to feel that he has passed into a different atmosphere. A certain unmistakable difference in voice and speech and a softer manner are, more than anything else, the first Southern characteristics to strike the stranger. The colored folk become more plentiful, and pickaninnies at the doors of whitewashed cabins form a not unfamiliar foreground touch in the landscape south of the city of Penn. From a car window one sees little of the change that comes over the face of Nature in passing from one region to another. But to him who fares by the way, with a keen instinct for things afield, comes the knowledge of just where the subtle change takes place. For it is by the range of country that a bird inhabits or where some particular tree or wild flower grows that Nature maps out the boundary lines of regions.

Naturalists have long recognized the fact that certain kinds of animals and plants were characteristic of certain regions of country, and that the boundaries of these regions coincided with lines of temperature or isotherms. Every species of animal and plant is definitely related to a certain fixed quantity of heat which is required for the full development of its reproductive activities. It is a habit fixed by purely physiological conditions. Various species of animals and plants, for some occult causes dating back to a remote period in their history, require a greater amount of heat throughout the period of reproductive activity than do other species, even though they be closely related. The species of animal or plant that requires the greater sum total of heat will find the northward limits of its range farther south than the species that requires a less amount. The breeding range of many birds, the dispersal of various species of mam-

mals and reptiles, and the growth and development of many different kinds of forest trees and wild flowers are thus definitely outlined.

Topographical conditions exert an important influence in the distribution of surface temperature. High mountain ranges, running southward, carry the cooler or more temperate conditions of the regions to the north along their crests far into the warm zone which they penetrate. Likewise, lowland plains, extending northward, carry the conditions of greater warmth into the cooler area of higher latitudes. It is not surprising, therefore, in passing from lowland to upland districts to find more or less of a change in the character of the vegetation and in the animal life. Certain species, quite abundant in the lowland region, disappear on the higher ground, where other kinds, not met with in the lowlands, make their appearance.

Through the researches of biologists * it has been found that the continent of North America may be divided north and south into several great temperature belts or heat zones, each one of which is characterized by peculiarities in its inhabitants. The boundaries of these heat zones are marked by isotherms which include a certain definite range of temperature that characterizes the contained area of country and which is definitely related to the reproductive functions of the animals and plants inhabiting it. It is an interesting fact to note that the isotherm representing the boundary between two of these heat zones coincides with the line that marks off the inland border of the Atlantic coast plain from the interior uplands of the highland region. If we turn our attention to the distribution of life in North America, we shall find some facts that do not quite agree with our already conceived ideas as to the divisions of the continent. An irregular line drawn from the coast of northern New England northwestward across the Great Lakes to the head waters of the Saskatchewan serves roughly to mark off a vast northern area known as the *boreal zone*. Its chief characteristic is the predominance of coniferous forests which stretch away northward to the Barren Grounds of arctic America. The inland border of the Atlantic coast plain, after bending around the end of the Appalachian highland region in northeastern Alabama, runs northward along the western base of the mountains to Lake Ontario. Then, turning sharply westward, it pursues an irregular course across the lower lake region and upper Mississippi Valley to the base of the Rocky Mountains. This extremely irregular line marks off a

* Especially those of Dr. C. Hart Merriam. See National Geographic Magazine, vol. vi, p. 229. The Geographic Distribution of Life in North America. From Smithsonian Report for 1891, p. 365.

vast territory to the south known as the *austral zone*. It is evident that the southern boundary of the boreal and the northern boundary of the austral zones do not coincide, but leave more or less of an intermediate territory where the peculiar types of the northern and the southern life mingle. This overlapping area is known as the *transition zone*.

Dr. Merriam has shown that these three great life zones—boreal, transition, and austral—are also temperature zones, each one of which is characterized by a definite sum total of heat throughout the reproductive period. Thus the mean daily summer temperature of the boreal zone never aggregates above ten thousand degrees Fahrenheit, while the daily temperatures of the transition zone always aggregate above this. The austral zone is marked by two temperature belts—the upper austral, aggregating above eleven thousand five hundred, and the lower austral, aggregating above eighteen thousand degrees Fahrenheit. It is a significant fact that this subdivision of the austral zone into two temperature belts conforms exactly with its subdivision into two characteristic life regions. The boundary separating these is indicated by a line that, starting at the mouth of Chesapeake Bay, runs southwestward to the borders of Georgia and Alabama, and, then turning northward, reaches the mouth of the Ohio. This line of demarcation coincides with what geologists know as the "fall line," where the various rivers, in their course from the highland region to the sea, break into a series of rapids as they flow from the higher and older formations of the Piedmont lands to the lower and more recent Tertiary deposits of the alluvial plains.

Each of these great zones is characterized by the presence of certain animals and plants that do not range beyond its limits. A traveler journeying northward from the tropical shores of the Gulf States, with their flocks of pelicans and flamingoes and their characteristic palms and mangrove swamps, marks the change from one region to another in the different species of plants and animals which he encounters. The change in vegetation alone is striking. The persimmons, tulip trees, magnolias, sweet gums, sassafras, papaws, and other forms that characterize the landscape of the Southern States give place to the oaks, hickories, and chestnuts, and, farther north, to the maple and beechwoods and the birches and aspens of the highland and mountain regions in the Middle States and New England. Beyond these deciduous woods of the transition zone the traveler enters the vast domain of coniferous forests that mark the boreal region of North America. Days of journeying through the wilderness of evergreens bring the wayfarer at length out into the "tree-line zone," scattered clumps of spruces and firs that

straggle along the southern edge of the inhospitable Barren Grounds of arctic America—a treeless, blizzard-swept waste of mosses and saxifrages, the home of the wolf, the musk ox, and the Barren Ground caribou, stretching away to the shores of the Arctic Ocean.

Zoölogists recognize several well-defined regions within these life zones, each of which is characterized by some forms of reptiles, birds, and mammals that do not range or breed beyond its limits. These geographical life areas have received the name of *faunas*. In the eastern United States four such regions are recognized and are known as the *Canadian*, *Alleghanian*, *Carolinian*, and *Louisianian* faunas. The Canadian fauna belongs to the boreal region. It is characterized by certain species of mammals that do not range south of it, as the moose, caribou, and wolverine, and by certain birds that breed within its borders. Among these latter are the well-known snowbird, several species of wood warblers, the winter wren, and the hermit thrush. This fauna extends southward to Georgia along the hemlock-crowned crests of the Appalachians, where the altitude produces conditions similar to those prevailing in the coniferous forests of the boreal zone to the north. Through the deep, cool shades of these hemlock woods floats the song of the hermit thrush—a vesper strain that falls on the sense like the tinkling of some far-off, sweet-toned bell, rising and swelling in an amplitude of liquid melody that fills the twilit aisles and dies away in still solitudes. The pleasing song of the snowbird breaks upon the forest stillness, quite different from its sharp, clicking notes so familiar in our winter walks about home. Along the brawling mountain brooks and trout streams of the Alleghanies the water thrush, with oddly jerking motions, bobs up and down on the rocks, and the winter wren flits about the windfalls or steals away from its nest, that is hidden under the gnarled roots of some old stump that overhangs the bank. To an ornithologist these and other features indicate a decided Canadian tinge in the summer bird fauna of the higher ranges from the Catskills to Georgia.

The so-called Alleghanian fauna of the eastern transition zone includes all the more familiar species of birds, reptiles, and mammals inhabiting the New England and Middle States and the lower ranges of the Appalachian highland to the south. Its chief characteristic is a mingling of the life of the other two zones—the boreal and the austral. Such decidedly northern forms as the bay lynx or catamount, the red squirrel, porcupine, woodchuck, chipmunk, jumping mouse, and certain other mammals find their ranges restricted along the southern boundary of this fauna. A number of familiar birds, as the brown thrasher, scarlet tanager, bluebird, house wren, chewink, indigo bird, meadow lark, the

orioles, the common dove, and the bob-white or quail do not breed beyond its northern boundary. The brook trout does not range south of this fauna, and the rattlesnake, the copperhead, the puff adder, the green snake, the milk snake, and the water snake are not found beyond its northern border.

The Carolinian fauna is a distinctly southern type and characterizes the upper austral zone, which includes that portion of the coastal plain region that reaches from the foot of the Appalachian highland to the "fall line" of the various Atlantic streams. The northern limit of this fauna thus coincides with the inland border of the coastal plain which we have already referred to and which may be looked upon as the *true dividing line between the North and South.* The presence of such birds as the cardinal, the yellow-breasted chat, the Carolina wren, the tufted titmouse, the Acadian flycatcher, and the blue-winged, Kentucky, and worm-eating warblers during the breeding season is a sure sign of the Carolinian fauna. These species never go beyond its northern limits. Moreover, such species as the brown thrasher, the wood thrush, the house wren, the chewink, the dove, and the field sparrow, which find their northern limit in the transition zone, are far more abundant in the Carolinian region, and might almost be regarded as representatives of its fauna.

It becomes a matter of profound interest, not only to the ornithologist and the student of geographical distribution, but to every one who has in his heart a love of woods and fields, to locate this natural boundary by such fine shadings as the nesting place of a bird or the habitat of a forest tree. Let us take that portion of the line that cuts off a small corner of southeastern Pennsylvania. To the ordinary observer this special tract of country presents no marked difference from the landscape a hundred miles or more to the north or south of it. Its detail of features is quite similar and seasonal changes follow much the same course that they do in northern Virginia and southern New England. To the northwest, beyond the low, irregular ridge of the "upland terrace" that marks the gneiss and schist rocks of an ancient shore line, the country breaks into the rolling hills and dales of the interior uplands. To the southeast lies the flat lowland of the Delaware plain, and beyond this the pine barrens and marshes of the Atlantic coast plain of New Jersey. One who has an eye for the woods, however, will note a certain change in the trees from southern New England and the highlands of the Middle States. Groves of tall tulip trees, with their broad, smooth leaves of shining green and large, creamy blossoms streaked with orange that open toward the end of May, form a characteristic feature of the woodland scenery. The sassafras and the persimmon are scattered more or less abundantly through the woods

and old pastures and along the borders of the streams. The sweet gum or bilsted, with its gray-colored branches winged with corky ridges, its spiny autumn fruit, and its five-starred leaves, fragrant when crushed and turning crimson in the fall, is a characteristic tree of this borderland. Curiously enough, too, it is confined to the lowlands, growing quite abundantly in the moist woods along the Delaware just south of Philadelphia, but unknown in the northern suburbs save as a transplanted tree.

These woodland features give a decided southern tinge to the region, and are especially significant when we come to know that the tulip tree belongs with the magnolias, a typical southern group, and that the persimmon is one of the ebony trees, a family characteristic of the tropics. But it is the presence of a Carolinian element in the fauna, especially the bird fauna, that marks this region as the beginning of the southern realm. At all seasons of the year the clear whistle of the Virginia redbird—the crested cardinal with mask of black—may be heard in the woods of the lower Delaware Valley and along the tributary streams. I have seen its flash of red against the whiteness of midwinter snowdrifts. In the bramble thickets that fringe the streams and on the wooded slopes above, the Carolina wren finds a home the year round, and its clear, ringing song breaks loudly on the frosty stillness of late winter mornings. I know of no more characteristic sounds in these woods in the early springtime than this wren's song and that of the tufted titmouse. It is a noteworthy fact that these three Carolinian birds are resident throughout the year along the northern limit of the fauna. When the spicebush has blossomed, and "all the wood stands in a mist of green," the first bird waves of the spring tide of migration appear. We wake some morning to hear the chipping sparrow striking pebbles together, and catch the plaintive song of the field sparrow in the pastures and the budding copses along the edge of spring woods. Only yesterday these sounds of the spring were but a memory. The thrasher pours out a medley of sweet notes from the high tree top, and later, in the warm days of early May, the reedy, mellow lute of the wood thrush comes from the bosky glade. During the migration the voices of birds sound unceasingly through the woods from dawn to twilight. When the blackberry is white with blossoms and the arrowwood is in bloom, most of the migrants have passed on to their northern breeding grounds, and those that stay with us have built their nests. Among these latter are several Carolinian birds. In the depths of smilax and brier-tangled thickets the skulking chat—the wildest bird of the woodland—utters its weird, delusive cries. The low-pitched, insectlike notes of the blue-winged warbler and the song of the worm-eating warbler that sounds like a chipping sparrow in the

underwoods, where a chipping sparrow is never found, remind the ornithologist that he is on the edge of the Carolinian zone, for these and the handsome Kentucky warbler find their breeding limit on the northern confines of this fauna.

One of the most characteristic birds of this region, and yet one of the most unfamiliar, is the curious barn owl, which makes its home in certain low tracts of woodland south of Philadelphia. Those of us who were brought up on the transatlantic story books of a generation ago know this bird as the strange-faced "staring owl" of our childish fancies. The barn owl of this country is only a geographical race of this long familiar owl of the English towers and belfries.

The turkey buzzard, though frequently observed as far north as southern New England, is never found abundantly beyond the Carolinian fauna. It nests among the rocks, often in communities of considerable size, in southern Pennsylvania, and winters in southern New Jersey. Almost any day from April to November numbers of turkey buzzards may be seen in the neighborhood of Philadelphia, soaring on motionless wing, often at a great height, or gathering in large flocks over the woods to feast on the carcass of some animal. Farther south, especially toward the coast, the turkey buzzard becomes less abundant where the black vulture or carrion crow, a closely related species that scarcely ever occurs north of Charleston, takes its place.

A notable mammal of the southern realm is at home in the woodland tracts of this region. The opossum is quite as abundant along the northern edge of the Carolinian fauna in southeastern Pennsylvania and New Jersey as it is farther south, but is rarely found north of this locality on the Atlantic seaboard. Its nocturnal habits preclude it from ordinary observation, and only in the autumn and early winter, when tempted into some rabbit snare or caught in its predatory midnight rambles and its fat body swings before the market door, are we aware that this curious marsupial dwells in our midst. From the Delaware southward a fat "'possum" is the delight of the darkey, and most toothsome is it indeed if caught in a persimmon tree after feeding on the frost-ripened fruit. A less common mammal is the little gray fox, which formerly was much more abundant on the northern range of the Carolinian fauna than it is at the present day. The gray fox must be the "Brer Fox" of Uncle Remus, for the more familiar and larger red fox of the Northern States does not range far beyond the limits of the transition zone. The red fox is now the most abundant species in southeastern Pennsylvania, and this may be due to a difference in habits. The gray fox makes his lair under the roots of a tree or a shelving rock, while the red fox tunnels out a burrowlike den underground. With

the clearing of the country this last is undoubtedly the most favorable method of holding territorial rights.

The southern portion of New Jersey presents a unique area in the Middle Atlantic States. In all its essential features—topographical, geological, and also in certain biological aspects—it is related to the region farther south, being the northward extension of the Atlantic coast plain. The most characteristic feature is the "pine-barren" region that reaches from the foot of the higher country to the maritime marshes and beaches that immediately fringe the coast. The tourist journeying to the seaside resorts south of Long Branch has the monotonous sandy waste of the pine barrens for a landscape. Here and there the white, loamy soil gives place to loose beds of yellow gravel. Sluggish streams of water, stained dark brown from the leachings of the cedar stumps, meander through swampy jungles. The landscape varies somewhat with the character of the trees in different places. In some sections the tall pitch pine forms vast stretches of forest, while in others a low and scanty woodland growth of the "Jersey" or scrub pine and several species of scrub oak prevails. The cedar swamps that lie scattered in the course of the numerous streams form a remarkable feature of this interesting region. Dense jungles of white cedar growing out of the dark water and surrounded by an impenetrable undergrowth of tangled vines and brier thickets form a harbor for many wild animals and birds. The tropical effect of these cedar swamps is heightened by broad-leaved magnolias and the long festoons of graybeard moss that fringe the branches. In these dark recesses, and through the pine barrens generally, the botanist finds many plants which belong to a more southern flora. Indeed, all the way along the coast from New Jersey to Maine, in favorable situations, representatives of distinctively southern forms may be found which in these higher latitudes do not occur inland. The mockingbird, which is highly characteristic of the Louisianian fauna, has been met with as a straggler during the breeding season in the New Jersey pine barrens; and in the cedar swamps near Cape May the hooded warbler, a typical Carolinian species, breeds regularly. In times long past the rare and curious Carolina parroquet, now known only from the Gulf region, was an occasional visitor as far north as the lower Delaware and its tributaries.

River valleys are topographical features of great importance in determining the distribution of living beings. The conditions of greater humidity and higher average temperature that prevail in the bottom lands along a river's course, as compared with the higher ground of the upland districts which forms its watershed, is strikingly illustrated in the case of Carolinian birds. Certain

species are found regularly during the breeding season in the valleys of the Susquehanna, Delaware, Hudson, and even the Connecticut Rivers, extending inland for a greater or less distance, but are unknown in the surrounding higher country. Thus, Carolina wrens, cardinals, turkey buzzards, and other no less characteristic Carolinian birds are abundant in the bottom lands along the Susquehanna in Lancaster County, Pennsylvania, but are scarcely ever found on the uplands above the wooded slopes of the river, though the conditions of food and shelter seem equally favorable.*

Much of the outside world enters a man's soul and becomes the ground of his joy through life. We all owe something to the region in which we dwell, unconsciously perhaps, but still something that is assimilated by the tissues of the inner life, and that goes to the making of what we really are. Those of us who dwell on the borderland of Dixie owe some fragmentary moments of inspiration, even of happiness, to the genial influence of its proximity. We think of ourselves as belonging with the North, but has not the South spun a few threads into the web of our lives? The cardinal whistles the same sweet tune as he does in "Old Virginia"; the opossum and the persimmon savor of the South; even the turkey buzzard suggests the warmer clime. And then spring is always two weeks earlier just down the Delaware, and this is something; even if it is too far off to start the "spring feeling," it hints of fresh early strawberries and the first run of the shad.

PROF. J. J. THOMSON, addressing the Section of Mathematics and Physical Science in the British Association, was able to testify to a great improvement which had taken place in the teaching of science in the public and secondary schools during the past ten years. The standard in physics attained by the pupils was increasing from year to year. There might, however, be danger of a temptation to make the pupils cover too much ground. "Although you may increase the rate at which information is acquired, you can not increase in anything like the same proportion the rate at which the subject is assimilated, so as to become a means of strengthening the mind and a permanent mental endowment when the facts have been long forgotten." In the university training of intending physicists the preservation of youthful enthusiasm was, in the speaker's opinion, one of the most important points for consideration; and this could best be effected "by allowing the student, even before he is supposed to be acquainted with the whole of physics, to begin some original research of a simple kind under the guidance of a teacher who will encourage him and assist in the removal of difficulties. If the student once tastes the delights of the successful completion of the investigation he is not likely to go back."

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* Witmer Stone. The Birds of Eastern Pennsylvania and New Jersey, p. 10.

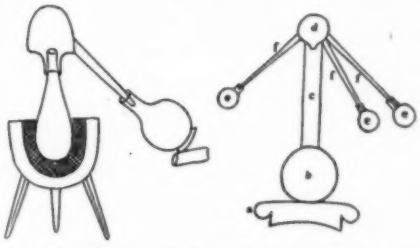
THE HISTORY OF ALCOHOL.

By Prof. CHARLES ERNEST PELLEW.

II.

IT is a curious fact that, although intoxicating beverages have been known and used from time immemorial, alcohol itself was not discovered until after the fall of the Roman Empire, and, when once discovered, it was not used for intoxicating purposes for many hundred years. Pliny, in his Natural History, written about A. D. 50, mentions that oil of turpentine could be extracted from the crude pitch by boiling the latter in open vessels and catching the vapors on fleeces, from which the condensed oil could be pressed. This marks the first beginnings of the art of distillation, which progressed but slowly, for, two hundred years later, we read that sailors were accustomed to get potable water from sea water by similar crude methods.

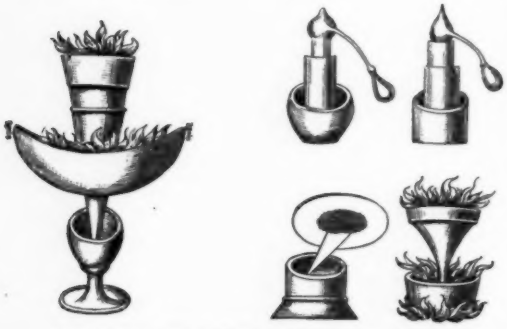
About this time there existed a flourishing school of alchemists at Alexandria, and it is probable that some of them had, or soon would have, developed the art further. But A. D. 287 the Emperor Diocletian destroyed their books and prohibited their studies, for fear lest by discovering the philosopher's stone, and hence learning to change base metals into gold, they might overturn the Roman rule. A more serious disaster befell the later Alexandrian School of Philosophy in the destruction of the famous Alexandrian Library by the Mohammedan general Amru, A. D. 984, at the orders of the Caliph Abu Bekr. "If the books agree with the Koran, they are not needed; if opposed, they are injurious." This was the argument which helped to put back civilization some centuries, and gave Literature, as well as science and medicine, a blow from which she has not yet recovered. It is curious to speculate what would be our present condition if only two or three of our recent advances—the discovery of galvanic electricity, for instance, or the germ theory of disease—had been made but one hundred years earlier.



Old Stills used by Alexandrians.

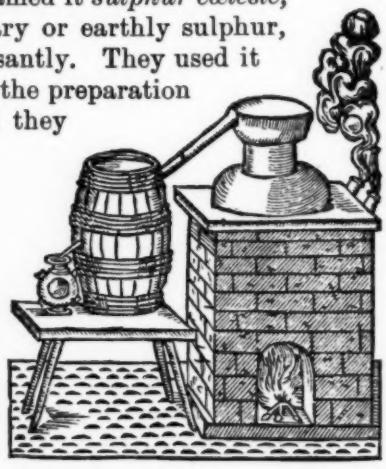
As it was, the study of science had to be begun over again almost from the very foundation by the Arabians under a more enlightened rule. The famous Geber about the close of the eighth century mentions the term distillation, but it is doubtful whether

he understood much more by it than the separation by heat of two metals of different melting points. Albucasis, a famous alchemist of the eleventh century, speaks of the process in less doubtful terms, and late in the thirteenth century the art of distillation and the preparation, properties, and uses of alcohol were clearly described by two European alchemists, Raymond Lully and Armand de Villeneuve.



Old Stills, from Early Edition of Geber.

In view of the fierce and indeed not undeserved abuse that has been levied against distilled liquors, it is interesting to note that for some hundreds of years after its discovery alcohol was distinctly the most valuable product of chemistry. The old alchemists went wild over it. They wondered at its power of dissolving oils and resins and balsams, calling it *oleum vini* and *balsamus universalis*, and making with it varnishes and perfumes and cosmetics, by the sale of which they replenished their not overfilled purses. They admired the clear, colorless, smokeless flame with which it burned, and named it *sulphur cœleste*, in contradistinction to the ordinary or earthly sulphur, which burns by no means so pleasantly. They used it as a preservative, they used it for the preparation of their chemicals, and above all they used it as a medicine.

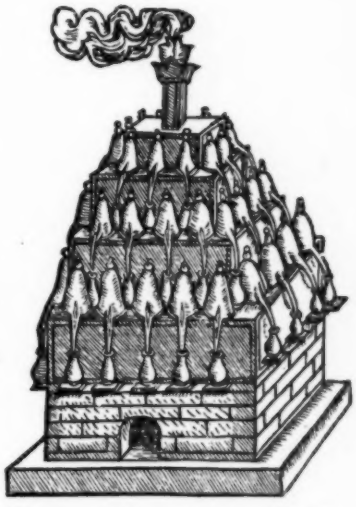


Still for Aqua Vitæ, Countrie Farme.

For during many hundred years this *aqua vitæ*, water of life as it was almost universally called, was the most valuable medicine in their large but inefficient pharmacopœia. Each alchemist, each physician, prepared his own elixirs, his own cordials, and claimed miraculous results for his own particular nostrums: but the basis of them all was the same—namely, alcohol, sweetened with sugar, and flavored by distillation or infusion with herbs and spices. Some of these "cordials" or heart remedies exist at the present day in the form of the various liqueurs. The Chartreuse and Benedictine are simply the same old medicines, prepared after practically the same old

formulæ, that the Carthusian and Benedictine monks used to distill hundreds of years ago to give to the sick and feeble at their convent doors, or sell to the wealthy invalid who sought their treatment.

But the curious part of it is not that it should have been used as a medicine, but that it should have been used as a medicine exclusively. There seems to have been little or no idea of its intoxicating power. In Shakespeare, for instance, there is abundant mention of drinking and drunkenness. But Cassio, and fat Sir John, and the rest got tipsy on sack, and canary, and sherry, or, if of lower rank, on ale and beer, but never on spirits. Indeed, the only mention of distilled liquors in all his plays is in Romeo and Juliet, where the old nurse sighs, "Oh, for some strong waters from Venice!" to restore her energies. As an example of how long this state of affairs continued I may mention a well-known book, The Countrie Farme, published in England in 1616. This large and important work discusses in great detail all the varied occupations of a large country place. It describes carefully the wine industry, the culture of the vines and grapes, the preparation and the varieties of wine, and, while highly praising good pure wine as a beverage, the author is extremely careful to describe fully and with much emphasis the many evil effects which come from intoxication, and from constant as well as from overmuch winebibbing.



HOUSEHOLD STILL, COUNTRIE FARME.

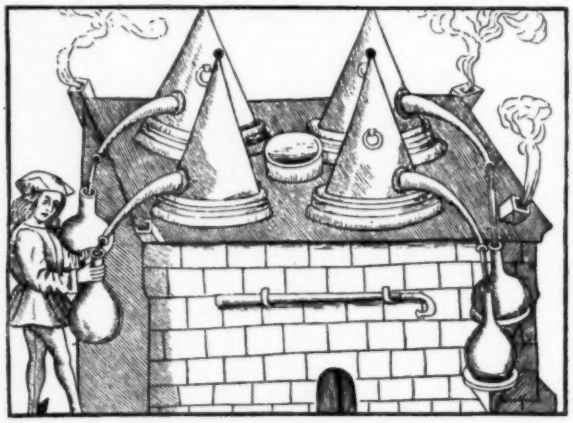
A few chapters further on the author describes the art of distillation. He explains that a still room was a necessary adjunct to a well-equipped country house, and shows curious illustrations of stills, some of them with sixty or eighty retorts on one oven. He mentions the great variety of vegetable and animal substances from which extracts could be and should be distilled, but spends most of his time upon the distillate from wine. "'For,' says he, "the virtues of *aqua vitæ* are infinite. It keepeth off fits of apoplexie—it driveth away venime.... In wet and malarial climates every one should take a teaspoonful, with sugar, before breakfast, to keepe off the ague," and so on. Not one word about intoxication—purely as a medicine.

It is not to be supposed from this, however, that the English

did not have plenty of ways of getting tipsy. They had long been known as ranking next to the Germans and the Dutch for their drinking powers. The Saxons and the Danes had both introduced into England the intemperate habits of the Northmen, and beer and cider, and mead or metheglin made from honey, were quite as efficacious in their way as stronger beverages. The Normans were a more refined and far more temperate race, and it is for this reason, in large part, that they conquered England so readily. The night before the battle of Hastings, so the old chroniclers tell us, was spent by the Saxons in drinking heavily and uproariously around their camp fires. "Next morning, still drunk, they recklessly advance against the enemy," so we read in the old monkish Latin, while the Normans, passing a quiet, peaceful night, were cool and well prepared for the decisive struggle.

TARTARS DISTILLING KOUMYSS.

Their habits, however, soon deteriorated, and they drank almost as heavily as their predecessors. In the reign of Henry I the nation suffered a grievous loss, from overindulgence in liquor, in the sad drowning of his eldest son, just married to a princess of France. The wedding party were returning to England on a galley, amid the rejoicing of both nations, and wine flowed freely on board, until even the seamen became intoxicated. As they were nearing the shore, the galley ran upon a sunken rock, and out of the whole company but one person escaped. The young prince, it was



ANCIENT STILL FOR EXTRACTION OF ESSENTIAL OILS AND PERFUMES.

said, with his bride and some attendants had pushed off from the ship in a boat, but he insisted on returning to try to save his sister, when the boat was upset, and all perished together.

All during the middle ages, in the chronicles of Froissart, Holinshed, and others, we find records of the fact that our Eng-

GEORGE IV AS PRINCE REGENT. (Gillray.)

lish ancestors, then as now, "liked a glass of good beer," and of wine too. Sir John Fortescue naively says, "They drink no water, except when they abstain from drinks, by way of penance and from principles of devotion." In 1498 the Spanish ambassador at the English court wrote to Ferdinand and Isabella to ask that Princess Catharine of Aragon, betrothed to Prince Henry, afterward Henry VIII, should learn to drink wine. This was a

good-natured tip from the English king and queen, who wished their future daughter-in-law to know that "water in England is not drinkable, and, even if it were, the climate would not allow the drinking of it." Heavy drinking was not by any means confined to the laity, for there are constant complaints of the habits of the clergy, and especially of the religious orders. The drunkenness of both monks and nuns was one of the main excuses for closing the monasteries by King Henry VIII. Good Queen Bess did not frown on the practice either, for, in the records of her visit to Kenilworth, 1575, we read that the Earl of Leicester broached three hundred and sixty-five hogsheads of beer, besides any amount of wine.

Toward the end of her reign drinking increased, thanks to the habits acquired by the volunteers in the Low Countries; and under her successor, the stupid and pedantic Scotchman, James I, the court itself set an ugly example to the people of England. We read that, at a great feast given by the minister Cecil to the king and to a visiting monarch, Christian IV of Denmark, James was carried to the bed intoxicated, and King Christian, less fortunate, rolled around very much under the influence of liquor and grossly insulted some of the ladies present. The latter, in their turn, before the evening was through, became quite as tipsy as the men, and, according to the testimony of an eye-witness, behaved most disgracefully. The nation sobered somewhat during the next reign and under the Commonwealth, only to return again to loose habits after the Restoration. And with the accession of the Dutch King, William, in 1688, the drinking assumed a more dangerous stage than ever.

For by this time people had at last learned that alcohol was intoxicating, and had also learned how to make it cheaply out of grain. Up to the seventeenth century all the *aqua vitæ* was made from wine, and was therefore expensive. But now they were able to make it from beer; and not only in France, at Nantes and elsewhere, but in Switzerland, and especially in Holland, at Schiedam and other places, great distilleries were pouring out vast quantities of cheap and fiery spirits. Early in William and Mary's reign encouragement was given to similar distilleries in England, on the ground of assisting agriculture, and by the beginning of the eighteenth century all England was flooded with native as well as imported gin at absurdly low prices.

The results were most disastrous. London streets abounded with ginshops, and one could actually find placards on them reading, "Drunk for a penny; dead drunk for twopence; clean straw for nothing." The effects on the common people were so marked that all thoughtful persons were alarmed by it. In the

wet, temperate climate of England people might drink heavily of beer or wine, and still in fair measure retain their health and their capacity for work; but, under the reign of gin, vice and misery and disease increased so fearfully that Parliament finally passed a law practically prohibiting its use.

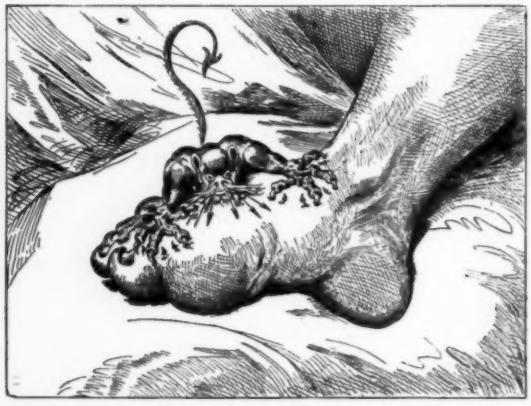
This famous "Gin Law," passed in 1736, is interesting as the earliest severe blow at liquor dealing among civilized nations. It levied a tax of twenty shillings a gallon on spirits, and a license of fifty pounds for any one selling or dealing in it. And, being in advance of public opinion, it failed much as other, more stringent, prohibition laws have failed in our own day. For the cry was at once raised that it taxed the poor man's gin, and let the rich man's wine go free. Every wit, every caricaturist, had his fling at it. Ballads were hawked round, telling of the approaching death of Mother Gin. The liquor shops were hung with black, and celebrated uproariously Madame Geneva's lying in state, her funeral, her wake, and so on. The night before the law went into effect, so the contemporary journals say, there was a universal revel all over the country. Every one drank his fill, and carried home as much gin, besides, as he could pay for.

To evade the law, apothecaries sold it in vials and small packages, sometimes colored and disguised, generally under false labels, such as "Colic Water," "Make Shift," "Ladies' Delight." There were printed directions on some of these packages—e. g., "Take two or three spoonfuls three or four times a day, or as often as the fit takes you." Informers were very prominent and exceedingly offensive, inventing snares to catch lawbreakers for the sake of the heavy rewards, and spying and sneaking around in a way particularly distasteful to the English mind. In consequence, they suffered in their turn. The mere cry "Liquor spy!" was enough to raise a mob in the London streets, and the informer was lucky if he escaped with a sound thrashing and a ducking in the Thames or the nearest horse pond. Indeed, such an outcry was made about the matter that the ministry became very unpopular, and the law was not enforced after two or three years, and was largely modified in 1743, after seven years' trial.

While the lower classes in England were thus being demoralized by gin, the upper classes were suffering almost as much from the introduction of the strong, sweet, fiery, heavily brandied wines of Portugal, thanks, in part at least, to some favoring clauses in the Methuen treaty, early in the eighteenth century. It is curious to read in the contemporary journals and diaries and in the histories and descriptions of the last century—as, for instance, in Trevelyan's Life of Fox—how terribly demoralized was the state of English society during the period of England's greatest colonial and material expansion. The country was gov-

erned by a small, wealthy, land-owning aristocracy, who seemed to take the most unbridled corruption in public, and the most unrestrained dissipation in private life as a matter of course. It was from the long years of peace under the Walpoles, during the first half of the century, when the energy and industry of the middle classes were able to exert themselves, and from the protection of her insular position, that England obtained strength to master her empire, not from any superiority in her governing classes.

For, all during the last century, drunkenness was the rule, not the exception, in all classes of society. In the lower classes it was actually encouraged. Did the troops win a victory, did a prince come of age, "Go home, Jack," would say the master to his servant, "build a big bonfire, and tell the butler to make ye all drunk." It was quite a compliment to call an underling an "honest, drunken fellow." And as for the gentlefolk—well, we can hardly conceive of the state of affairs. It was part of a gentleman's education to learn to carry his port. One, two, three quarts a night was a proper and reasonable supply. After dinner the ladies retired into another room—a practice still observed—so that the men should have no embarrassing restraints, and it was a matter of course for them to drink one another under the table as fast as was convenient. In the army and navy, in the learned professions, among the gentry and nobility, and even in the royal family, heavy drinking was the rule and not the exception until well on in the present century.



THE GOUT. (Gillray.)

And they suffered from it. Their lives were shortened, their usefulness impaired, their estates squandered, and then the gout! Nowadays, with the example of Palmerston and Bismarck, Gladstone and Sherman before our eyes, it is hard to think of a time when statesmen were incapacitated at thirty-five or forty. But it was so. A gentleman who reached middle age without being crippled was either unusually lucky or was a milksop. Lord Chatham and many, nay most, of his contemporaries were horribly tortured by it. At critical periods in the nation's history a

severe onset of gout, or the illness leading up to it, would cause the retirement of the most prominent statesmen. Many of them died young. Few indeed of them reached a healthy and vigorous old age. For heavy drinking was not confined to the idlers and

49
Twenty Pounds a T-Tun additional Duty
u-u-if you'd don't like it at that why t-t-t-then
Dad & I will keep it all for o-o-our own Drinking
so here g-g-goes old Bu-Bu-Bull & Mouth!-
Pray Mr Bacchus have a bit of consideration
For old John;- you knows as how Five
emptied my Purse already for you - It is
reamedly hard to raise the Price of a drop
of Comfort now that ones got no Money
left for to pay for it!!!
WINE
TREASURY BENCH

JOHN BULL PETITIONING PITT AND DUNDAS TO LIGHTEN THE LIQUOR TAX. (Gillray.)

spendthrifts, the courtiers and country gentlemen; it was a custom with the ablest and most brilliant men in England. Pitt and Fox, the two "Great Commoners," were noted topers. The old couplet is still remembered that refers to a scene in the House of

Commons when Pitt and his friend Dundas came staggering in, and Pitt says: "I can not see the Speaker, Dick; can you?" "Not see the Speaker? Hang it, I see *two*." And all through the regency and well on through the next reign until the accession of the young Queen, there prevailed what to us would seem unpardonable license.

But it must not be inferred from this that drinking was much *more* prevalent in England than in other parts of the world at the same periods. Indeed, the records of Germany and Holland show quite as startling pictures. And in our own country we have not much to boast of.

The North American Indians were, on the whole, unaccustomed to alcoholic beverages before the arrival of the white man. Tobacco they had, and used it freely. In some stray localities we read of drinks made from maize; and from the reports of Captains Amadas and Barlow to Sir Walter Raleigh about the expedition to Virginia in 1584, we find that the Indians along the coast of Chesapeake Bay and the Carolinas had learned the art of making wine from grapes. But when the Puritans landed in Massachusetts in 1620 they found, to their disgust, that beer and wine were both lacking, and we find Governor Bradford complaining bitterly of the hardship of drinking water.

Nor was water a more favored beverage among the settlers of Massachusetts Bay eight or ten years later. The first list of necessities sent back to the home company, in 1629, is headed, as our New England friends have so frequently reminded us, by an appeal for "ministers," and for a "patent under seale." We do not hear so often of their request, only a line or two further down, for "vyne planters." They ask for wheat, rye, barley, and other grains, and also for "hop rootes."

The records are still kept of the equipment of the vessel sent out in answer to this appeal. It was provisioned for one hundred passengers and thirty-five sailors for three months, each sailor counting as much as two passengers. They provided for the voyage "forty-five tuns beere, at four and six shillings per tun; two caskes Mallega and Canarie at sixteen shillings; twenty gallons aqua vitæ," and—for drinking, cooking, and all, only six tuns of water!

Higginson, the well-known first minister, went out in 1628. The next year he wrote home a glowing account of the country. Among other things, the air was so fine that his health was greatly benefited. "And whereas my stomache could only digest and did require such drinke as was both strong and stale, now I can and doe oftentimes drinke New England water verie well."

This really remarkable fact we find explained a few years after by Wood, in his New England's Prospect. He says that the

country is well watered, and with different water from that of England; "not so sharpe, of a fatty substance, and of a more jetty colour. It is thought that there can be no better water in the world; yet dare I not preferre it to good Beere as some have done. Those that drinke it be as healthful, fresh, and lustie as they that drinke beere."

By 1631 they had passed a law for putting drunkards in the stocks; other laws followed concerning adulterations, sale to savages, etc. In 1634 the price of an "ale quart of beere" was set at a penny, and brew houses were soon in every village, in some places attached to every farm. The manufacture of other drinks followed rapidly, and in Judge Sewall's diary, some forty or fifty years later, we find mention of ale, beer, mead, metheglin, cider, wine, sillabub, claret, sack, canary, punch, sack posset, and black cherry brandy. The commonest of all these was "cyder," which was produced in enormous quantities and drunk very freely. Sack was passing out of date, excepting in posset, a delectable mixture of wine, ale, eggs, cream, and spices, boiled together. Metheglin and mead were brewed from one part of honey and two or two and a half parts of water and spices, fermented with yeast, and very heady liquors they were. The least excess, as they used to say, would bring back the humming of the bees in the ears. Governor Bradford early issued one of his orders against some "Merrymount scamps" on board the bark Friendship, who took two barrels of metheglin from Boston to Plymouth, and "dranke up, under the name leakage, all but six gallons."

But none of these, nor the "beveridge" and "swizzle" made from molasses and water, the perry, peachy, spruce and birch beer, and the rest, did half as much execution as rum. This was introduced from Barbadoes about 1650, and from then on became practically the national drink of the country. A great trade was set up with the West Indies, the ships exporting corn and pork and lumber for the plantations, and returning with cargoes of raw sugar and molasses, which last was almost valueless where it was made, but, diluted and fermented, furnished a ready source of alcohol.

Every little New England town and village had its distillery —the seaport towns had scores of them—and the rum bullion, rumbooze, or, as it was universally known, killdivil, was sold freely for two shillings a gallon, and was shipped largely to the African coast in exchange for slaves. It was to this profitable trade that Newport and other New England coast towns owed their prosperity, and the interference with this trade by the English Commerce Acts was one of the main causes of the Revolution.

This rum was the basis not only of "flip," when mixed with beer, molasses, dried pumpkin, and sometimes cream and eggs, and stirred, before serving, with a red-hot poker, but also of punch. This latter, named after an East Indian word meaning five, was concocted with sugar, spices, lemon juice, and water, and was imbibed freely. As early as 1686 we find travelers telling of noble bowls of punch, which were passed from hand to hand before dinner. Double and "thribble" bowls there were also, holding two or three quarts each, and the amounts that our ancestors disposed of in those days are staggering.

For liquor was not only used at dinner and supper parties; it was taken morning, noon, and night, as a matter of course. The laborer would not work at the harvest, the builders at their trades, without a liberal allowance of rum. It did not matter, either, what class of work they were doing. When the little town of Medfield, early in the last century, "raised" the new meeting house, there were required "four barrels beer, twenty-four gallons West Indian rum, thirty gallons New England rum, thirty-five pounds loaf sugar, twenty-five pounds brown sugar, and four hundred and sixty-five lemons." A house could not be built without liquor being distributed at every stage of the operation, and this practice was not obsolete till well on in this century.

The clergy, while keeping a strict eye upon the excesses of their parishioners, did not disdain a drop themselves, and their conventions rivaled the dinners of the non-elect. In 1792 Governor Hancock gave a dinner to the Fusileers at the Merchants' Club in Boston, and for eighty diners there were served one hundred and thirty-six bowls of punch, twenty-one bottles of sherry, and lots of cider and brandy. But a similar bill is preserved for the refreshments at the ordination of a clergyman at Beverly, Mass., in 1785, and we notice:

	£	*s.*	*d.*
30 Bowles Punch before they went to meeting	3	0	0
80 people eating in morning, at 16*d.*	6	0	0
10 bottles of wine before they went to meeting	1	10	0
68 dinners at 30*d.*	10	4	0
44 bowles punch while at dinner	4	8	0
18 bottles wine	2	14	0
8 bowles brandy	1	2	0
Cherry Rum	1	10	0
and 6 people drank tea	0	0	9

It would be but useless repetition to discuss the drinking habits of New York and other colonies. It is enough to say that well on into the present century drunkenness was extremely common, and, when people could afford it, a most pardonable and venial offense. It is the pride of our civilization in the present century that, during the last fifty or seventy-five years, the whole

tone of society has changed, and intemperance, while still unfortunately prevalent, is nothing like as common as it used to be.

Indeed, it is hardly possible for us to imagine the state of affairs in our grandfathers' times. A hundred years ago a gentleman who went out to dinner, and was not brought home in the bottom of a cab or in a wheelbarrow, was a very poor-spirited fellow indeed. So with the poorer classes. Just a century ago George Washington was engaging a gardener, and in his contract it was expressly stipulated that he should have "four dollars at Christmas, with which he may be drunk for four days and four nights; two dollars at Easter to effect the same purpose; two dollars at Whitsuntide, to be drunk for two days; a dram in the morning, and a drink of grog at dinner at noon." Nor was the sum mentioned a niggardly one, when George Washington was distilling his own whisky, and selling it, probably, for thirty or forty cents a gallon.

And now, just think of the change. We can hardly imagine a gentleman perceptibly exhilarated with wine at a dinner table. He certainly would never get a second opportunity, if the fact were known. And as for the working classes—a clerk, an engineer, a coachman, or even a gardener whose breath smelt of whisky, or who was seen often dropping into a saloon, would run a good chance of losing his position.

For the world has at last found out what intoxication means. Alcohol in large doses is a poison, but it is a poison which injures the family and neighbors and friends of the inebriate more than the victim himself. It, to some extent at least, causes him discomfort, but think of the discomfort it causes his family! It shortens his life, to be sure, but think of the other lives that it shortens! And while some attack the problem with fierce and violent denunciations, and others by quieter and not the less effective arguments and appeals, the world certainly owes a debt of gratitude to those who are doing so much now, and who have done so much already, to relieve mankind from the burden of inebriety.

THE electric telegraph cable laid five years ago between the Senegal coast of West Africa and Pernambuco, Brazil, has broken twice about one hundred and fifty miles from the African coast. On examining it for repairs, the cable was found surrounded by great quantities of vegetable growth, with refuse and rubbish of various kinds; while the color of the sea changed to a dirty brownish green, indicative of the presence of river water; yet the nearest stream was a great distance away, flowing at its point of discharge in a direction different from that of this spot. It was supposed to be a sudden outburst of a submarine gully or stream. A number of such streams or fresh-water submarine wells are known, but how gourds, pieces of orange peel, and scraps of carpets, such as were found around the cable, got into them, remains a mystery.

THE MOB MIND.

By Prof. EDWARD A. ROSS.

IN viewing social life among animals one is struck by the contagion of feeling in a herd or flock. Whatever the feeling called up, whether terror, hostility to a stranger, rage at hereditary enemies, sympathy for a stricken fellow, or the impulse to migrate, all the members of the group feel it, and feel it almost at once. If anything unusual occurs, a wave of excitement passes over the herd, followed by instant and unanimous response. Of inquiry or doubt or reflection there is no sign.

This prompt obedience to suggestions from one's fellows is accounted for the moment we recall the harsh conditions of animal existence. It is the gregarious animals that are least formidable by nature and hence most dependent on mutual aid. Instant fight or flight is the condition of their existence, and failure to cooperate promptly means death. By oft-repeated sifting out of the stupid, the heedless, or the willful, Nature builds up a marvelous suggestibility and a most alert response to sign. Not otherwise can we explain why a feeling should run like wildfire through a band of elephants or terror should strike through a herd of deer as a shock passes through a solid body.

The human analogue to the agitated herd is the mob. Mob comes from "mobile," and refers to mental state. A crowd, even an excited crowd, is not a mob; nor is an excited crowd bent on violence a mob. Great mental instability marks the true mob, and this characterizes only the crowd that is under the influence of suggestion. A lynching party may be excited, disorderly, and lawless, yet not be a true mob. The crowd that lynched thirteen Italians in New Orleans a few years ago, far from showing the wavering indecision of the genuine mob, seemed to know exactly what it wanted and just how to go about it. In this respect it stood in high contrast to the Cincinnati mob of 1886. What distinguished the New Orleans crowd was the absence of epidemic. Its perfect unanimity came not from an overmastering suggestion, but from the coming together of all who had been affected with the same grim rage at the news of Chief Hennessey's assassination.

Again, we must refuse the name "mob" to the disorderly masses that in times of tumult issue from the criminal quarters of great cities. In such cases there is an unchaining in each man of the evil and secret lusts of his heart on observing that opportunity is favorable and that others are like-minded. Safe from punishment or shame, the ragamuffin or hoodlum burns, loots, and riots in obedience not to a common impulse but to his natural inclination. It is this peculiar effect of numbers in bringing on

the criminal mood that chiefly marks off the human crowd from the animal crowd.

More than any other animal, man is restrained by a morality founded not on impulse but on discipline. Animal morality is mainly the prompting of fellow-feeling. But by the long pressure of an artificial environment man is brought to submit himself to the constant sway of a moral code often quite alien to his impulses. Remove the fear of consequences by the anonymity of the crowd, take away the sense of personal responsibility by the participation of numbers, and people will step by step descend into depths of evil-doing and violence that measure how far their prevailing inclinations lie below the moral standard which social pressure has forced upon them. Animals, because they have been less *moralized* than men by education, rarely show any such collective *demoralization.*

A *one-mindedness*, therefore, the result not of reasoning or discussion or coming together of the like-minded, but of *imitation*, is the mark of the true mob. We think of the mob as *excited* simply because it is under stress of excitement that men become highly imitative. *Fickleness* and *instability* characterize it simply because mood changes promptly with every change in the nature of the suggestion. It is *irrational* because dominated not by the remembered teachings of experience but by the fleeting impressions of the moment. It is *cowardly* because its members, actuated not by stern purpose or set resolve but by mere suggestion, scatter in craven flight the moment the charm is broken. It is *transitory* because the orgy of excitement leads to fatigue and lessened power of response to stimuli from without. In a few hours the hyperæsthesia wears away, physical wants and sensations turn the attention inward, the psychic bond is broken, and the crowd disperses and goes home. A mob, then, defined for purposes of social psychology, is *a crowd of people showing a unanimity due to mental contagion.* Other traits of the mob of which much is made—such as ferocity, shamelessness, criminality, courage, intolerance, etc.—need not flow from suggestion at all. More often, as I have pointed out, they are the effect of the sense of numbers.

Analyzing the mob as thus defined, we find at the base of it that mental quality termed *suggestibility* which comes to light in gregarious animals, children, certain lunatics, hysterical patients, and hypnotized subjects. It dominates childhood, but fades as character sets and the will hardens. In adult life it is so overborne by habit and reason as to be dominant only under abnormal conditions such as disease, fascination, or excitement.

Why, now, should this quality be heightened when one is in the midst of a crowd ?

The inhibitive power which measures our ability to go our own way undisturbed grows with the variety and number of suggestions that reach us. This may be because conflicting suggestions block each other off. The power of independent choice seems to develop best when the clash of suggestions reduces to a minimum the ascendency of the outer world over the individual. This is why age, travel, and contact with affairs build up character. But when numerous identical suggestions beset one, one's power of resistance is gradually undermined. As many taps of a hammer fracture the bowlder, so the onset of multitudinous suggestion breaks the strongest will. Men who can readily throw off the thousand suggestions of everyday life will be quite swept away by the reiteration of a single idea from all sides. As a mighty organ compels even benches and windows to vibrate in unison with it, so the crowd dominated by a single mood emits a volume of suggestion that gives an emotional pitch and tone to every individual in it.

Besides the volume of suggestion possible in a crowd, there is usually a condition of excitement or expectancy. Frequently, too, there is a pressure on the body which prevents voluntary movement while conveying promptly to each all those electrifying swayings and tremors that express the emotions of the mass. The mere physical contact in the excited crowd, therefore, provides certain conditions of suggestibility.

A cross-section of the mob sometimes shows a concentric structure. There is in the center a leader from whom suggestions proceed. These, caught up by those near by and most dominated by his personality, are transmitted to the next circle with an added force. Thus the suggestion passes outward from zone to zone of the crowd, at each stage gathering volume and hence power to master the rest. That, therefore, which started at the center as fascination becomes sheer mental intimidation at the rim. This symmetrical type of mob has led some to look in every case for the *leader* who controls the mass by his personality or prestige. But the quest for a nucleus, while it makes the study of mobs more mysterious and sensational, certainly does not make it more scientific. Rarely does the primitive impulse proceed from one man. Usually the first orientation of minds is brought about by some object, spectacle, or event. This original phase, the moment it is observed by the members of the crowd, gives rise to three results: (1) By mere contagion the feeling extends to others till there is complete unanimity; (2) each feels more intensely the moment he perceives that the rest share his feeling; (3) the perceived unison calls forth a sympathy that makes the next agreement easier, and so paves the way for the mental unity of the crowd.

The mob is thus a formation that takes time. In an audience falling under the spell of an actor or an orator, a congregation developing the revival spirit, a crowd becoming riotous, or an army under the influence of panic, we can witness the stages by which the mob mood is reached. With the growing fascination of the mass for the individual, his consciousness contracts to the pin point of the immediate moment, and the volume of suggestion needed to start an impulse on its conquering career becomes less and less. In the end, perhaps, any commanding person can assume the direction of the mob.

It must be manifest, however, that there are a hundred cases of imitation of the many for one case where the entire mass throughout obeys a single person. In accounting for the mob, hypnosis has no such scope of application as the theory of mental intimidation. If we suppose that the eye of the leader or the gesture of the orator paralyzes the will of the crowd as the "bright object" of the hypnotizer overcomes his subject, we shall not get the mob without *presence*. But if the secret of its unanimity lies in mass suggestion, why is presence necessary? May there not be mob phenomena in a multitude of people not collected at one spot within sight and sound of each other?

It has long been recognized that the behavior of city populations under excitement shows the familiar characteristics of the mob quite apart from any thronging. Here we get unanimity, impulsiveness, exaggeration of feeling, excessive credulity, fickleness, inability to reason, and sudden alternations of boldness and cowardice. In fact, if you translate these qualities into public policy, you have the chief counts in the indictment which historians have drawn against the city democracies of old Greece and mediæval Italy.

These faults are due in part to the nervous strains of great cities. The continual bombardment of the attention by innumerable sense impressions is known to produce neurasthenia or hysteria, the peculiar malady of the city dweller. Then, too, there thrive in the sheltered life of the city many mental degenerates that would be unsparingly eliminated by the sterner conditions of existence in the country. But aside from this the behavior of city dwellers under excitement can best be understood as the result of mental contacts made possible by easy communication. While the crowd, with its elbow-touch and its heat has no doubt a maddening all its own, the main thing in it is the contact of minds. Let this be given, and the three consequences I have pointed out must follow. An expectant or excited man learns that a thousand of his fellow-townsmen have been seized by a certain strong feeling, and meets with their expression of this feeling. Each of these townsmen learns how many others

are feeling as he does. Each stage in the consequent growth of this feeling in extent and in intensity is perceived, and so fosters sympathy and a disposition to go with the mass. Will we not inevitably by this series of interactions get that "out"-look which characterizes the human atom in the mob?

The bulletin, the flying rumor, "the man in the street," and the easy swarming for talk or harangue open those paths between minds, and prepare those contacts that permit the ambient mass to press almost irresistibly upon the individual. But why will this phenomenon be limited to the people huddled on a few square miles of city ground? Mental touch is not bound up with proximity. With the telegraph to collect and transmit the expressions and signs of the ruling mood, and the fast mail to hurry to the eager clutch of waiting thousands the still damp sheets of the morning daily, remote people are brought as it were into one another's presence. Through its organs the excited public is able to assail the individual with a mass of suggestion almost as vivid as if he actually stood in the midst of an immense crowd.

Formerly, within a day a shock might throw into a fever all within a hundred miles of its point of origin. The next day it might agitate the zone beyond, but meanwhile the first body of people would have cooled down and would be disposed to listen to reason. And so, while a wave of excitement passed slowly over a country, the entire folk mass was at no moment in the same state of agitation.

Now, however, our space-annihilating devices, by transmitting a shock without loss of time, make it all but simultaneous. A vast public shares the same rage, alarm, enthusiasm, or horror. Then, as each part of the mass becomes acquainted with the sentiment of all the rest, the feeling is generalized and intensified. A rise of emotional temperature results which leads to a similar reaction. In the end the public swallows up the individuality of the ordinary man, as the crowd swallows up the will of its members.

It is plain that in matters of policy this instant consensus of feeling or opinion works for ill if it issues in immediate action. Formerly the necessary slowness of focusing and ascertaining the common will insured pause and deliberation. Now the swift appearance of a mass sentiment threatens to betray us into hot-headed or ill-considered measures. Sudden heats and flushes take the place of reflection and resolve; and with this comes a growing impatience with the checks and machinery that prevent the public from giving immediate effect to its will. As the working of representative government thus becomes less clumsy, there disappears some of that wholesome deliberateness which has distinguished indirect from direct democracy.

Mob mind working in vast bodies of dispersed individuals gives us the *craze* or *fad.* This may be defined as *that irrational unanimity of interest, feeling, opinion, or deed in a body of communicating individuals which results from suggestion and imitation.* In the chorus of execration at a sensational crime, in the clamor for the blood of an assassin or dynamiter, in waves of national feeling, in war fevers, in political "landslides" and "tidal waves," in passionate "sympathetic" strikes, in cholera scares, in public frights, in popular delusions, in religious crazes, in "booms" and panics, in agitations, insurrections, and revolutions, we witness contagion on a gigantic scale, favored in some cases by popular hysteria. It is best to keep the term "craze" for an imitative unanimity arrived at under great excitement, while "fad" is that milder form of imitation which appears in sudden universal interest in some novelty.

As there must be in the typical mob a center which radiates impulses by fascination till they have subdued enough people to continue their course by sheer intimidation, so for the craze there must be an excitant, overcoming so many people that these can affect the rest by mere volume of suggestion. This first orientation is produced by some event or incident. The murder of a leader, an insult to an ambassador, the sermons of a crazy fanatic, the words of a "prophet" or "Messiah," a sensational proclamation, a scintillating phrase, the arrest of an agitator, a *coup d'état,* the advent of a new railroad, the collapse of a trusted banking house, a number of deaths by an epidemic, a series of mysterious murders, and an inexplicable occurrence such as a comet, an eclipse, a star shower, an earthquake, or a monstrous birth—each of these has been the starting point of some fever, mania, crusade, uprising, boom, panic, delusion, or fright. The more expectant, overwrought, or hysterical is the public mind, the easier it is to set up a great perturbation. Even clergymen noted a connection between the "great revival" of 1858 and the panic of 1857. After a series of public calamities, a train of startling events, a pestilence, earthquake, or war, the anchor of reason finds no "holding ground," and minds are blown about by every breath of passion or sentiment.

The fad originates in the surprise or interest excited by novelty. Roller-skating, blue glass, the planchette, a forty days' fast, the "new woman," tiddledy-winks, faith-healing, the "13–14–15" puzzle, baseball, telepathy, or the sexual novel attract those restless folk who are always running hither and thither after some new thing. This creates a swirl which rapidly sucks into its vortex the soft-headed and weak-minded, and at last, grown bigger, involves even the saner kind. As no department of life is safe from the invasion of novelty, we have all kinds of

fads: literary fads like Maeterlinck or the Decadents; philosophic fads like pessimism or anarchism, religious fads like spiritualism or theosophy; hygienic fads like vegetarianism, "glaming," "fresh air," mush diet, or water cure; medical fads like lymph, tuberculin, and serum; personal fads like short hair for women, pet lizards, face enamel, or hypodermic injections of perfumery. And of these orders of fads each has a *clientèle* of its own.

In many cases we can explain vogue entirely in terms of novelty fascination and mob mind. But even when the new thing is a step in progress and can make its way by sheer merit, it does not escape becoming a fad. It will have its penumbral ring of imitators. So there is something of the fad even in bicycling, massage, antisepsis, skiagraphy, or physical culture. Indeed, it is sometimes hard to distinguish the fad from the enthusiastic welcome and prompt vogue accorded to a real improvement. For the uninitiate the only touchstone is time. Here as elsewhere "persistence in consciousness" is the test of reality. The mere novelty, soon ceasing to be novel, bores people and must yield to a fresh sensation; the genuine improvement, on the other hand, meets a real need and therefore lasts.

Unlike the craze, the fad does not spread in a medium specially prepared for it by excitement. It can not rely on heightened suggestibility. Its conquests, therefore, imply something above mere volume of suggestion. They imply prestige. The fad owes half its power over minds to the prestige that in this age attaches to the new. Here lies the secret of much that is puzzling.

The great mass of men have always had their lives ruled by usage and tradition. Not for them did novelties chase each other across the surface of society. The common folk left to the upper ten thousand the wild scurry after ruling fancy or foolery of the hour. In their sports, their sweethearting, their mating, their child-rearing, their money-getting, their notions of right and duty, they ran on quietly in the ruts deeply grooved out by generations of men. But a century or so ago it was found that this habit of "back"-look opposed to needed reforms the brutish ignorance, the crass stupidity, and the rhinoceros hide of bigotry of the unenlightened masses. Accordingly, the idea of the humanitarian awakening that accompanied the French Revolution was to lift the common folk—the third estate—from the slough of custom to the plane of choice and self-direction. And for a hundred years the effort has been to explode superstition, to diffuse knowledge, to spread light, and to free man from the spell of the past and turn his gaze forward.

The attempt has succeeded. The era of obscurantism is forever past. With school and book and press progress has been taught till with us the most damning phrase is "Behind the

times!" But we now see that a good deal of the net result has been to put one kind of imitation in place of another. Instead of aping their forefathers, people now ape the many. The multitude has now the prestige that once clothed the past. Except where rural conservatism holds sway, mob mind in the milder forms of fad and craze begins to agitate the great deeps of society.

Frequently a half-education has supplied many ideas without developing the ability to choose among them. The power to discriminate between ideas in respect to their value lagging far behind the power to receive them, the individual is left with nothing to do but follow the drift. Ideas succeed one another in his mind not by trial and rejection, but in the order of their arrival on the scene. Formerly people rejected the new in favor of wont and tradition; now they tend to "go in" for everything, and atone for their former suspiciousness by a touching credulity. The world is abuzz with half-baked ecstatic people who eagerly champion a dozen different reforms in spelling, dress, diet, exercise, medicine, manners, sex relations, care of children, art, industry, education, and religion, each of which is to bring in the millennium all at once.

These minds that, broken from the old moorings of custom, drift without helm or anchor at the mercy of wind and tide, are social derelicts. They follow the currents of opinion; they can not create them. At all times ripples chase each other over the surface of society in the direction of improvement—sudden but all-pervading interest in "how the other half lives," in the abolition of war, in rational dress, in out-of-door sports, in "a white life for two." Had these ripples a real ground swell beneath them, the world might soon be made over. But, alas! they are only ripples. They wrinkle the surface of people's attention for an instant, but in a moment their fickle minds are responding to a new impulse in a different direction.

If this were to be the outcome of the attempt to emancipate the common man and fit him to be helmsman of society, we might well despair. Certainly the staid, slow-going man of olden times, plodding along the narrow but beaten path of usage, is as dignified a figure as the unsteady modern person whose ideas and preference flicker constantly in the currents of momentary popular feeling. The lanes of custom are narrow; the hedgerows are high, and view to right or left there is none. But there are as much freedom and self-direction in him who trudges along this lane as in the "emancipated" man who finds himself on an open plain, free to go in any direction, but nevertheless stampedes aimlessly with the herd.

The remedy for mob mind, whether presented in the liquefaction of our city folk under modern conditions of mental intimacy

or in the mad rush of the public for the novelty of the hour, is not in replanting the hedgerows of custom. We must go forward, keeping in mind, however, that the chief present need is not to discredit the past but to discredit the mass. The spell of ancestors is broken; let us next break the spell of numbers. Without lessening obedience to the decision of majorities, let us cultivate a habit of doubt and review. In a good democracy blind imitation can never take the place of individual effort to weigh and judge. The frantic desire of frightened deer or buffalo to press to the very center of the throng does not befit civilized man. The huddling instinct has no place in strong character. Democracy's ideal is a society of men with neither the "back"-look on the past nor yet the "out"-look on their fellows, but with the "in"-look upon reason and conscience. We must hold always to a sage Emersonian individualism, that, without consecrating an ethics of selfishness, a religion of dissent, or a policy of anarchism, shall brace men to stand against the rush of the mass.

ARE SCORPIONS MATRICIDES AND SUICIDES?

By Dr. JUAN VILARÓ,
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IT is by no means a rare thing to see a simple coincidence designated and accepted as a cause. Such is the case with the erroneous though common and deep-rooted belief that the newly born scorpions devour their mother during the first period of their life. Science has dispelled this vulgar error, as it has done away with the absurd assertions about the *vegetating wasp* and other species of animals.

It is a well-known fact that the little scorpions, when they come into life, place themselves at the sides and upon the back of their mother, where they remain huddled together while their transformation is being completed, or, in other words, until they change their first skins (exuviation or ecdysis).

At this moment the little scorpions break away and commence *on their own hook* their lively search for food, thus entering the wide field of the struggle for existence.

During this period of their life the mother may die. The difficult and hazardous process of delivery is oftentimes the cause of such death. The ants hasten to do away with the remains, and this is the origin of the common but erronecus belief that the mother has fallen a victim to the voracity of her own offspring.

As I have always been impressed by the grandeur of small things, and as phenomena of apparent insignificance are often of

great importance, I resolved to find out the truth through my own experiments, with the following results:

A few years ago I introduced into a capacious flask a she scorpion with her offspring of fifty little scorpions. They lost no time in regaining their position upon the mother's back, to which they regularly returned every time they were forcibly dislodged. In order to excite the voracity of the little ones, I withdrew all food from their reach, and even mutilated one of the mother's legs. The hæmorrhage thus produced failed to give the result hoped for. The fifty little scorpions changed their

Rock Scorpion.

skins and subsequently died of hunger. The mother came out unscathed. I repeated the experiment upon a later occasion, in Jamaica, placing together two different breeds upon one mother's back. The weak little scorpions died, as was to be expected, of starvation, and I vainly tried to provoke their voracity with the mother's blood.

But if science has exonerated scorpions from the horrible crime of matricide, it is by no means so clear that they are entirely deprived of the faculty of maiming themselves, and even of making attempts on their own life, an inclination which they possess in common with many other animals.

The assertion that scorpions, when surrounded by fire and deprived of all means of escape, commit suicide, was first advanced by Paracelsus. Some naturalists delare this to be a fact, while others deny it. Among the latter we may count Brehm, who,

while acknowledging that the scorpion when thus tortured does sometimes commit suicide, does not believe it is intentional. "Nature," says Brehm, "has set apart man as the only being, in all creation, who under certain circumstances enjoys the dire privilege of destroying *his own self*." My own observations and experiments, carried out in July, 1881, at the sugar estate "Osado de Lagunillas," jurisdiction of Cardenas (Cuba), in the presence of several relatives and friends, authorize me to assert that the scorpion, after repeatedly attempting to emerge from the circle of fire by which it is surrounded, drawing its cheliform appendages toward its mouth whenever they come in contact with the fire, wounds itself with its own sting in the place called by Flourens the vital point, instantly dying.

I may add that the same experiment has been performed, with identical results, on specimens of different ages, sex, and strength by persons who are wholly deserving of my confidence.

E. Blanchard, Paul Bert, Jousset de Bellesme, and Joyeux-Laffine have studied the poisonous apparatus of the scorpion and the effects resulting therefrom.

The toxic matter is a transparent liquid of acid reaction, which dries easily, is readily dissolved in water, and insoluble in absolute alcohol and ether.

"The scorpion's poison," says Joyeux-Laffine, "is very active, although it lacks all the toxic strength which some authors have attributed to it. Its effects are directly proportionate to the quantity introduced into the system. One drop of this poison in a pure state, or even mixed with a small quantity of water, is sufficient to produce instant death when injected into the cellular tissue of a rabbit. Birds succumb to it as readily as mammals. One drop of this poison is sufficient to kill seven or eight frogs. Fish, and especially mollusks, are not so susceptible. The articulates, however, are surprisingly affected by this poison; the one hundredth part of a drop suffices to kill a good-sized crab. The flies, spiders, and insects upon which the scorpion feeds are, so to speak, fulminated by the sting of this animal."

THE doctrine of multiple souls among the Calabar negroes is described by Miss Kingsley as including the notion of four souls—the soul that survives death, the shadow on the bush, the dream soul, and the bush soul. The bush soul is detachable from the body, but if damaged or killed in its wanderings the body suffers the same fate. Hence old people are held in respect, even if known to be wicked, because their bush souls must be particularly powerful and astute. The soul that survives death is liable to reincarnation either in a higher or lower form. The dream soul is the particular care of witches, who lay traps for it and return it to the owner on payment.

SKETCH OF HORATIO HALE.

GREAT advances have been made by ethnologists of the present generation in the study of the languages of the American aborigines and in the investigation of primitive linguistics. The pioneer in these researches, one whose efforts have been among the most fruitful, the one who perhaps has so far gone deepest into the investigation, was Horatio Hale, who died at Clinton, Ontario, December 29, 1896. "By his death," says his fellow-student in this subject, Dr. Franz Boas, in The Critic, "ethnology has lost a man who contributed more to our knowledge of the human races than perhaps any other single student." The sketch that follows was carefully prepared nearly two years before Mr. Hale's death. Although a few changes of form might have been proper to adapt it to the present date, we prefer to publish it as it was left, only inserting a few words respecting Mr. Hale's distinguished mother.

HALE, HORATIO, M. A., ethnologist and lawyer, was born on May 3, 1817, at Newport, N. H. His father, David Hale, was a leading lawyer of that town, and his mother, Sarah Josepha, after her husband's death in 1822, became well known in American literature as a highly esteemed author and editor. [Her nursery poem, Mary had a Little Lamb, has endeared her to children's hearts, and other fugitive productions of hers have become widely familiar. She was for one year less than a half century editor of the Ladies' Magazine, Boston, and, after its merger in that periodical, of Godey's Ladies' Book, Philadelphia, which had an immense circulation for its day and was a living force in shaping the tastes and aims of American women. She was one of the earliest advocates of the advancement and higher education of women, and was the virtual founder of the engagement of women in foreign missionary service and of the Woman's Union Missionary Society for heathen lands. Through her urgency the women of New England contributed fifty thousand dollars toward the completion of the Bunker Hill Monument; and mainly through her urgency and correspondence with Governors of States and Presidents of the United States Thanksgiving Day was made a national festival.] Their son showed an early inclination for the study of languages, and particularly of the Oriental and aboriginal American tongues. At the age of sixteen he entered Harvard College. In the following year, when a party of Indians from Maine came to Massachusetts and encamped for a time on the college grounds, he took the opportunity of collecting a vocabulary of their dialect. This, with some accompanying remarks, was printed in 1834 in a small pamphlet, which was

distributed among scholars interested in linguistic science. As a result of this and other like evidences of qualification he was appointed in 1837, the year of his graduation from the university, to the office of philologist and ethnographer in the United States Exploring Expedition to the Pacific, under Captain (afterward Admiral) Charles Wilkes. The expedition occupied the years from 1838 to 1842. Mr. Hale's report on Ethnography and Philology, composing the seventh volume of the expedition series, and filling nearly seven thousand quarto pages, appeared in 1846. It is devoted to the physical and mental characteristics, the customs, and the languages of the natives of the Pacific islands (including Polynesia, Micronesia, and Melanesia), and of Australia, northwest America, Patagonia, and southern Africa. The eminent ethnologist, Dr. R. G. Latham, in the preface to his work on The Natural History of the Varieties of Man (1890), describes the contents of Mr. Hale's volume as "the greatest mass of philological data ever accumulated by a single inquirer." He quoted from it freely, as does also Prof. Max Müller in his Lectures on the Science of Language (second series), where he refers particularly to the "excellent Polynesian grammar."

The two portions of this volume which attracted most attention at the time of its publication, and have since most materially influenced the sciences to which it related, are the section which treats of the migrations of the oceanic islanders and that which is devoted to the tribes of northwestern America. The first of these sections, by a large accumulation of traditional and linguistic evidence, determined the origin of the Polynesians from a single island of the Malaisian Archipelago, and fixed not only the probable time and place of their first appearance as emigrants in the Pacific Ocean, but also the period of their settlement in each of the principal groups, showing that both the original migration and the subsequent dispersion were events of comparatively recent occurrence, probably beginning but little before the Christian era, and that the dispersion was, in fact, still going on in our century. The other portion made known for the first time the extraordinary number and variety of languages in northwestern America. The "ethnographical map" prepared by the author showed in what was then the Oregon Territory, comprising the present States of Oregon and Washington, no less than thirty languages and dialects, belonging to twelve distinct stocks, differing totally from one another in both vocabulary and grammar. This is more than twice the number of stocks that are found in the whole of Europe. These and other similar facts led to a theory afterward proposed by Mr. Hale to explain them, as will presently be recorded.

After the publication of this report Mr. Hale spent a few

years in foreign travel and in the study of law, and in 1855 was admitted to the bar of Illinois at Chicago. In the following year he removed with his family to Canada West, taking up his abode in the then newly formed town of Clinton, on an estate which had descended to his wife, a lady of Anglo-Canadian birth. Here he has since devoted his time partly to professional pursuits and to local undertakings of public utility, and partly to scientific researches. For the latter, an ample field was found among the Indians inhabiting the many "reserves" which the considerate legislation of the various provinces has set apart for them. One of the most important of these is the "Six Nations' Reserve," near Brantford, occupied by about three thousand Indians, mostly Iroquois, but with several groups belonging to other stocks. Here he had the good fortune of discovering two native manuscripts in different Iroquoian dialects—Canienga (or Mohawk) and Onondaga—one of them dating from about the middle of the last century (soon after the language was reduced to writing by the missionaries), which proved to be of much historical and ethnological interest. They gave an account of the renowned confederation of the Five (afterward Six) Nations, or Iroquois tribes, which was formed about four hundred years ago, under the celebrated Onondaga chief Hiawatha. This great chief and lawgiver, whom Longfellow, following Schoolcraft's lead (though well aware of the absurd misapplication of the name), has transported to the shores of Lake Superior and converted into an Ojibway hero of romance, was a genuine historical personage, as authentic as Alfred or Washington. At the request of the distinguished ethnologist, Dr. D. G. Brinton, Mr. Hale prepared a translation of these manuscripts, which was published in 1883 in Dr. Brinton's well-known Library of American Aboriginal Literature, with several introductory chapters on the history, customs, and character of the Iroquois people, the whole forming an octavo volume of about 220 pages. Of this work, which is entitled The Iroquois Book of Rites, the eminent historian and philologist, Dr. J. G. Shea, has said: "It is a philosophical and masterly treatise on the Iroquois league and the cognate tribes, their relations, language, mental characteristics, and policy, such as we have never before had of any nation of this continent." The American Journal of Philology adds: "Mr. Hale's book is likely to make an epoch in North American Indian history, giving as it does a clearer insight than we have had before into the political constitution and fortunes and the personal character of the famous 'Six Nations,' who played so prominent a part in the land before and during the Revolutionary War."

On the same reserve Mr. Hale made another notable discovery. He had heard that there was living on the reserve an Indian of

great age—reputed, indeed, to be over a century old—who was believed to be the last full-blooded survivor of the once numerous Tutelo tribe. This tribe formerly inhabited Virginia and North Carolina, and migrated thence in the last century to Pennsylvania and New York, where they united with the Iroquois "nations," and finally removed with them to Canada. Mr. Hale visited this old man, and obtained from him and some intelligent half-castes (of Tutelo-Iroquois origin) an extensive vocabulary of their language, with many historical facts, which showed them to be beyond question members of the great Dakota (or Siouan) stock of the far West. It also appeared that other tribes near them spoke the same language. The fact that septs of their widespread family anciently dwelt east of the Alleghanies, and in all probability occupied this North Atlantic portion of the continent before its invasion by the Iroquois and Algonkin tribes, was an important and unexpected addition to aboriginal history. The particulars of this discovery were given in a paper of considerable length, entitled The Tutelo Tribe and Language, which appeared in the Proceedings of the American Philosophical Society of Philadelphia, and was thence reprinted in pamphlet form. It naturally aroused much interest among American ethnologists.

In 1882 Mr. Hale, as a member of a committee of the American Association for the Advancement of Science, which met in that year in Montreal, took part in organizing the first meeting of the Section of Anthropology in that association; and, somewhat remarkably, two years later in the same city he was one of the committee of the British Association which organized the first meeting of the like section in that world-renowned society. These facts afford evidence both of the recent rise and progress of this branch of science and of the position held by Mr. Hale among its cultivators. At this meeting of the British Association a proposal of the first president of the new section, the distinguished anthropologist, Dr. E. B. Tylor, resulted in the appointment of a committee "to investigate the physical character, languages, and industrial and social condition of the Northwestern tribes of the Dominion of Canada." Of this committee Mr. Hale was a member, having among his colleagues the late eminent President of Toronto University, Sir Daniel Wilson, and Dr. G. M. Dawson, of the Geological Survey of Canada. In compliance with the unanimous request of his colleagues, Mr. Hale undertook the office of director of the investigations and editor of the reports—an office which, under the rules of the association, involved his temporary withdrawal from the committee. Of these reports eight have already appeared, and another, designed to be the final report, is now (January, 1895) in course of preparation. The first report, which was on the Tribes of the Blackfoot

Confederacy (who, though belonging to the Algonkin family, may from their character and achievements be styled the Iroquois of the Northwest), was prepared by Mr. Hale, partly from his own minutes, gathered in Oregon in former years, and partly from materials supplied by his correspondence with two highly esteemed missionaries, Catholic and Methodist—the Rev. Father Albert Lacombe and the Rev. Dr. John McLean. This report was presented in 1885, and proved of so much interest that before it appeared in the association's volume it was published in the English periodical Nature, and was thence reprinted in the American Popular Science Monthly. In this report, as well as in his annotations on the third report, prepared partly by his experienced collaborator, the Rev. E. F. Wilson (well known as the founder of the Shingwauk Home at the Sault Ste. Marie), Mr. Hale sought to show that the remarkable superiority of the Blackfoot Indians to the other Algonkins is due to an admixture of blood with the Kootenays of British Columbia, whose singular mental endowments are set forth in two of the subsequent reports, the sixth and eighth. All the reports after the third, with the exception of the eighth, which is by Dr. A. F. Chamberlain, formerly of Toronto University and now of Clark University, Worcester, Mass., have been prepared by Dr. Franz Boas, formerly editor of Science, who, like Mr. Wilson and Dr. Chamberlain, was invited by Mr. Hale to carry on the investigations. The reports, usually prefaced by introductory remarks of the editor, have been of considerable length, some of them comprising many pictorial illustrations, and have proved a conspicuous feature of the recent volumes of the British Association. They have been considered of so much importance that the Canadian Parliament has twice supplemented by considerable money grants the sums liberally appropriated for the committee's work by the British Association. The fifth report contained a colored "linguistic map" of British Columbia, prepared at Mr. Hale's suggestion, and supplementing his ethnographical map of Oregon, already noticed. This British Columbian map showed five linguistic stocks, additional to the twelve stocks comprised in the Oregon map, thus evidencing the existence of no less than seventeen language families in an area not larger than the British Islands. This remarkable fact, with some similar instances in other parts of the world, offered one of the most perplexing enigmas of philological science.

This enigma Mr. Hale undertook to solve in an address delivered in 1886 before the Section of Anthropology in the American Association for the Advancement of Science, of which association he had been elected one of the vice-presidents and chairman of that section. The address was on The Origin of

Languages and the Antiquity of Speaking Man. In this essay he maintained that the human race, when first endowed with articulate language, was necessarily of one community and one speech, and that the origin of the various linguistic stocks is due to a force which is in constant activity, and which may be styled "the language-making instinct of very young children." Many instances of languages thus spontaneously created by children were given; and in a later paper on the Development of Language, read before the Canadian Institute of Toronto, in 1888, as a sequel to the address, and published in the Journal of the Institute and afterward separately, further evidence was produced to show that the words and grammar of such languages might, and in many cases probably would, be totally different from those of the parental speech. In the original address the fact was pointed out that in the first peopling of every country, when, from various causes, families must often be scattered at wide distances from one another, many cases must have occurred where two or more young children of different sexes, left by the death of their parents to grow up secluded from all other society, were thus compelled to frame a language of their own, which would become the mother-tongue of a new linguistic stock. It is evident that, along with their new language, these children and their descendants would have to devise a new religion, a new social policy, and in general new modes of life, except in so far as reminiscences of the parental example and teachings might direct or modify the workings of their minds. All these conclusions, it is affirmed by Mr. Hale, in his Introduction to the Committee's Sixth Report to the British Association, "accord precisely with the results of ethnographical investigations in America."

He further maintained that while, according to the evidence adduced by geologists, we must believe that a being who had the form and some of the faculties of man (including probably some partly developed power of speech) existed in the Quaternary era, many thousands and perhaps many ten thousands of years ago, all the evidence points to the conclusion that social man, of the existing species, fully endowed with the human faculties, including that of articulate speech, appeared only some seven or eight thousand years back; and, further, that when "speaking man" thus appeared, his mental like his physical capacity—though, of course, not his knowledge—was fully equal to the capacity of any of his descendants.

The solution thus offered of the linguistic problem was received with more prompt and general favor than is usually accorded to novel theories. Prof. Abel Hovelacque, well known as one of the most eminent philologists and ethnologists of Europe, and now the official director of the School of Anthro-

pology in Paris, reviewed the address of 1886 at length in the periodical *L'Homme* for September of that year, and, while dissenting from some of its physiological suggestions recommended the philological conclusion very strongly to the attention of scholars. Prof. Sayce, in his presidential address of 1887 to the Section of Anthropology in the British Association, spoke in equally commendatory terms, merely asking for some additional evidence, which the author of the theory endeavored to supply in his Canadian Institute paper already referred to. Prof. G. J. Romanes, in his Mental Evolution of Man, quotes largely from Mr. Hale's address—to the extent of nearly a fourth part of the whole essay—accepting the author's conclusions and fortifying them by other evidence. Prof. Henry Drummond, in his recent work, The Ascent of Man, takes a similar view. Lastly, Dr. Brinton, in his important work on Races and Peoples (which he dedicates to Mr. Hale), has given his opinion on the subject in clear and decided terms. "Those convolutions of the brain" (he writes) "which preside over speech being once developed, man did not have to repeat his long and toilsome task of acquiring linguistic faculty. Children are always originating new words and expressions, and if two or three infants are left together, they will soon have a tongue of their own, unlike anything they hear around them. Numerous examples of this character have been collected by Mr. Hale, and upon them he has based an entirely satisfactory theory of the source of that multiplicity of language which we find in various parts of the globe."

In 1889 Mr. Hale was elected a Fellow of the Royal Society of Canada. To their translations he contributed, in 1891, a paper entitled Language as a Test of Mental Capacity. This essay was also separately reprinted, with the additional title of An Attempt to demonstrate the Tone Basis of Anthropology, and attracted hardly less attention from ethnologists than his address of 1886. It received from the Anthropological Institute of Great Britain and Ireland the unusual compliment of being republished in full in their quarterly journal—despite its length of thirty-six quarto pages. It was also reprinted in four sections in successive numbers of The American Antiquarian for the following year, under the title of Man and Language. A review of this paper in Nature (June 30, 1892)—anonymous, but bearing clear evidence of the style of Prof. Max Müller—speaks of Mr. Hale as "the Nestor of American philologists, and, at the same time, the Ulysses of comparative philology in that country," and of his paper as "an important essay." The eminent reviewer adds: "All his contributions to American ethnology and philology have been distinguished by their originality, accuracy, and trustworthiness. Every one of them makes a substantial addition to our knowl-

edge, and, in spite of the hackneyed disapproval with which reviewers receive reprints of essays published in periodicals, it is much to be regretted that his essays have never been published in a collected form." In the North American Review for July, 1892, the distinguished President of McGill University, Sir J. William Dawson, refers to this "remarkable paper of Mr. Hale's" as "one which should commend itself to the study of every biblical scholar and archæologist." He adds: "In this paper Mr. Hale maintains the importance of language as a ground of ethnological classification, and there was his wide knowledge of the languages of American aborigines and other rude races to show that the grammatical complexity and logical perfection of those languages imply a high intellectual capacity in their original framers. . . . On similar grounds he shows us that it is not in the outlying barbarous races that we are to look for truly primitive man, since here we have merely degraded types, and that the primitive centers of man and language must have been in the old historic lands of western Asia and northern Africa."

In 1893 Mr. Hale was elected President of the American Folk-lore Society. He had previously contributed to the society's quarterly journal a series of articles on Huron Folklore from materials gathered in his visit to the "Underdon Reserve," on the Detroit River opposite to southern Michigan—the reserve appropriated to the small band of Wyandot Indians, less than a hundred, who alone in Canada retained the language, and with it the traditions, of the once numerous and powerful Huron people. In the same year he was invited to attend the International Congress of Anthropology, which was convened for the World's Columbian Exposition at Chicago. To this congress he contributed a paper entitled The Fall of Hochelaga, a Study of Popular Tradition, which appeared in the volume of Memoirs of the congress, and also in the Journal of the American Folklore Society for March, 1894. In this paper he was enabled, by employing the same methods of research and analysis by which he had in early life traced out the Polynesian migrations of two millenniums, to elucidate, by the aid of traditions which had been preserved for more than four centuries among the Canadian Hurons, a singular historical mystery, which had long perplexed the writers of North American annals. When the explorer Jacques Cartier, in 1535, discovered and ascended the St. Lawrence River, he found its shores, from what is now the site of Quebec to what is now the site of Montreal, occupied by what he styled the "kingdom of Hochelaga." Its "great king and lord," from his capital at the last-named place, ruled over several communities of partly civilized Indians, who spoke a language of the Huron-Iroquois stock.

They lived in commodious bark-covered houses, cultivated extensive maize fields, and had encircled their chief town with a triple row of tree trunks, planted as palisades, and thus making it a fortress of great strength. When Champlain, nearly sixty years later, ascended the river for the purpose of founding near it a French colony, this "kingdom," with all its subject towns, had disappeared. "A few wandering Algonkins occupied, but hardly pretended to possess, the country which had been the seat of this lost empire." Its destruction has been generally ascribed to the attacks of these Algonkins. Mr. Hale's inquiries proved conclusively that this supposition was an error. The Huron traditions showed that in times long prior to Cartier's visit the Huron and Iroquois nations, speaking similar dialects, or perhaps the same dialect, had dwelt in unity near together along the St. Lawrence; that at length a rupture, of which the occasion and circumstances are minutely remembered, took place, followed by a desperate conflict; that this conflict caused at first the retreat of the Iroquois people to the region which is now northern New York; and, finally, after a long-protracted warfare, resulted in the defeat of the Hurons and their expulsion from their former seats. The Algonkins, instead of being their enemies, were their friends and allies, and still remained, when Champlain arrived, the bitter enemies of the Iroquois.

This outline of Mr. Hale's scientific work may be properly concluded by an extract from a brief sketch of his life, which appeared in the Cyclopædia of Canadian Biography: "He contributed to periodicals in the United States, Great Britain, and Canada, on scientific and literary topics, and has taken particular interest in educational matters. Through his efforts the Clinton High School and the Clinton Mechanics' Institute and Library Association were established, and he was for many years chairman of the High School Board and President of the Institute. While holding these positions he gave much time to correspondence and interviews with the Ontario authorities, and to the circulation of petitions to the Legislature, which resulted in largely increased public grants to the high schools and mechanics' institutes throughout the province, and in legislation which greatly enhanced their efficiency. One important result of the legislation thus promoted by Mr. Hale, it may be mentioned, was to secure the admission of female pupils into the high schools, on the same terms and with the same advantages which were allowed to male pupils—a privilege which had previously been denied to them. Mr. Hale has also taken part in various public enterprises, and, in especial, was chairman of the committee which secured the means for the construction of the London, Huron, and Bruce Railway—a successful work, which has added largely to the prosper-

ity of the fertile and rapidly improving district through which it passes." Mr. Hale was an honorary or corresponding member of many learned societies, including, besides those mentioned in the foregoing sketch, the Anthropological Societies of Washington and Vienna, the Polynesian Society of Wellington, New Zealand, the Numismatic and Antiquarian Society of Philadelphia, the New England Historico-Genealogical Society, and several others.

A few days before his death Mr. Hale was notified by the Secretary of the British Association for the Advancement of Science that the Council of that body desired him to act as vice-president of the Section of Anthropology at the next meeting, at Toronto in 1897. The letter declining to accept this position, on account of failing health, was one of the last from his pen.

[Mr. Hale's first scientific publication was the first systematic contribution to the study of the Malaisian and Polynesian languages, and cast a flood of light on the subject at the outset. His last published contribution presented evidences that the native tribes of America possessed at the time of the discovery a higher degree of civilization than any one had before ascribed to them, evincing "intellectual and moral faculties of no mean order"; that they had established forms of government, a real money, "the elements of a written language, widely diffused, and employed especially in preserving, with happy effect, the memory of treaties of peace and alliance"; and a very high degree of generally diffused comfort. In preparing this paper for publication in the Journal of the Anthropological Institute of Great Britain and Ireland, for February, 1897, Mr. E. B. Tylor mentions having received, while writing, the intelligence of Mr. Hale's death with regret, but hardly with surprise, and adds: "The tone of his letters for months past had been that of a man looking toward the end of his work in life, and anxious to settle finally all matters he had much at heart. Among these were his investigations into the history of his friends the Iroquois and Hurons, to which he had given so much labor, and of which his last studies, undertaken to elucidate their native records, form a fit completion." At the conclusion of his tribute to Mr. Hale in The Critic, Dr. Franz Boas says: "His wise counsel, his amiable guidance, his kindly friendship, insure a grateful memory to him whose works students of ethnology and of linguistics will admire for all time to come. Science has lost a worker to whose enthusiasm and faithful labor we owe much; mankind has lost a man whose wisdom, kindness, and steadfastness it is hard to lack."]

Editor's Table.

THE DUKE OF ARGYLL ON EVOLUTION.

THE Duke of Argyll is a writer who finds it very hard to reconcile himself to the doctrine of evolution in the only form in which it can ever prove satisfactory to the scientific world. He believes in evolution, or, as he prefers to call it, development; but he wants to have it in a shape to suit himself, with little touches of special creation thrown in here and there, to ease off the difficult places and keep in touch with older modes of thought. He has lately returned to the subject in an article in The Nineteenth Century, some of the observations in which seem to us deserving of attention.

In the first place, we have the complaint that "the very word 'development' was captured by the Darwinian school as if it belonged to them alone, and the old familiar idea was identified with theories with which it had no connection whatever." The fact is that, if the Darwinian school captured the word development, it was not so much the result of a freebooting raid on their part as of the complete abandonment and rejection of the *idea* of development, in all that related to the origin of species, on the part of that orthodox school to which the duke gives so much sympathy. As his Lordship remarks, the facts of development had long been conspicuous in embryonic growth and in the production of plants from seeds; and yet when the idea was broached that one species might have been "developed" out of another, or that the work of creation could have proceeded otherwise than by a succession of special divine fiats, the whole orthodox world was up in arms. The "facts" of development, in spite of the "familiarity" on which the duke lays stress, had really done nothing to modify popular conception on this subject; on the contrary, opinion in the age just preceding Darwin was less enlightened by far than had been the views of many early thinkers, including that rigid doctrinarian St. Augustine. The idea of development, as applied to the origin of species, was, we may therefore say, forced upon an unwilling world by Darwin; and it is no wonder, consequently, if to some extent the idea became identified in the public mind with the Darwinian theory.

We can not agree with the duke in his criticism of the term "natural selection." The question is not how the term has been understood by careless or ignorant people, because such will always make a bungle of things, but whether it has concealed any false implications for those who have made a thoughtful use of it. The duke says that "it resorted to the old, old Lucretian expedient of personifying Nature and lending the glamour of that personification to the agency of bare mechanical necessity and to the coincidences of mere fortuity." We doubt whether, in the minds of serious thinkers, such a "glamour" ever attached to the term. On the contrary, we are persuaded that to such it suggested nothing beyond a kind of automatic movement in Nature by which the adaptation of organisms to their cosmic surroundings became ever closer and closer. His Lordship says that Darwin was led to the phrase "by

an intellectual instinct which is insuperable—viz., the instinct which sees the highest explanations of Nature in the analogies of mental purpose and direction. *But*," he adds, "Darwin neither saw nor admitted its implications." If Darwin neither saw nor admitted its implications—by which the writer means its teleological implications—it was a very blind instinct indeed which led him to choose the term *because* of those implications. The fact is that Darwin had little choice in the matter. Human language is necessarily so tinctured with the idea of purpose that it is extremely difficult to find terms expressive of action which do not in some degree or other seem to imply purpose. Then we are told that "the great bulk of Darwin's admirers rejoiced in his theory for the very reason that it rested mainly on the idea of fortuity." How does this agree with the previous statement that the success of the term "natural selection" was chiefly due to the glamour it threw over men's minds as being a kind of personification of Nature? It seems as if his Lordship had not quite made up his mind as to what his views really are on this point.

We are told, not for the first time, that "it would be as rational to account for the poem of the Iliad, or for the play of Hamlet, by supposing that the words and letters were adjusted to the conceptions by some process of natural selection, as to account by the same formula for the intricate and glorious harmonies of structure with function in organic life." Statements of this kind, we must confess, seem to us rather inept. The argument is: the words of the Iliad or of Hamlet are so arranged as to render certain meanings; we know that these words were chosen by a conscious intelligent agent; wherever, therefore, we find that any arrangements in Nature are adapted to produce definite effects, we are entitled to conclude that those arrangements also had their origin in conscious and purposive effort. In other words, because results are reached in one case, or in certain cases, by purposive efforts, they must be so in all cases. Manifestly the conclusion is illicit, and yet the argument is continually being served up to us in essentially this shape. The duke talks of the "intricate and glorious harmonies" of Nature, but does he rest his argument on harmonies of this rich order? If so, where does he draw the line? How intricate and how glorious must a harmony be in order to make good its claim to a purposive origin? And may it be assumed that humbler harmonies may be the result of unconscious processes? This is no trivial logic-chopping question; it is all-important. We presume, from the duke's seeming to rest his argument on the higher harmonies, that he is prepared to abandon the lower to the reign of purely physical law; and if so, the believer in natural selection and other evolutionary formulas would like to know the extent of his conceded domain. Our impression is that, if he once gets a foot of space in the world of action and reaction, no "pent-up Utica" will long confine his powers. We may say as much of the contrary theory: once make it plain that any adaptation in Nature is distinctly purposive, and the dominion of purpose will become a universal dominion.

From our point of view, we must frankly confess, the idea of purpose is simply a drag on the interpretation of Nature. It is one of those short cuts which it does not pay to take. In so far as we assume purpose we cease to be interested in method or process. Voluntary action only comes in to do that which could not be effected by involuntary action;

and therefore if, in tracing back any chain of causation, we come to a point where we conclude that voluntary action manifests itself, we do not seek an explanation of *that*. It does not follow, however, that, because the idea of purpose is a drag on the scientific interpretation of Nature, it has no place in a rational scheme of thought. It is possible to believe, and with deep conviction, in purposes that can not be traced; and this, in our opinion, implies a more truly religious spirit than the attempt to read the petty thoughts of man into the everlasting statutes of the universe. To undertake, as the Duke of Argyll does, to indicate at what precise points in the sequence of events there must have been the introduction of a divine power does not seem to us to be religious in the best sense. At best of times we know but in part; where we know not at all let us acknowledge our ignorance, but let us not say that, because we are ignorant, we must surely be upon holier ground.

Since the above was written, a further article by the Duke of Argyll in criticism of Mr. Spencer's views has been given to the world; and, as we have our hand in, we may as well deal with it in the remaining space at our disposal. The writer declares very positively that we deceive ourselves "when we think or talk of organs being made or fitted by use," the idea being, he says, "strictly speaking nonsense," as organs are made "for use, not by use." This would be an important statement if there was only the least reason for believing it to be true, which there is not. The distinguished disputant simply assumes the conclusion which it is the purpose of his lengthy argumentation to prove. We can claim with tolerable confidence to know that organs are formed, or have been formed, by the combined action of use and natural selection, but we have absolutely no knowledge in regard to the deliberate formation of organs *for* use. We can not even begin to imagine what the nature of such a process would be.

The duke makes, however, a true and important remark when he says that "we have no antecedent knowledge of the Creator which can possibly entitle us to form any presumption as to his methods of operation." How vain, then, to say that He intervenes to form organs for use, creating them first in a very rudimentary form, and gradually improving them in the course of ages! It is because of their profound conviction that the Creator's ways are past finding out—that they can not possibly be level with the comprehension of man—that evolutionists limit themselves so strictly to the simple sequence and filiation of phenomena. When the duke says that he "can not accept, or even respect, the opinion of men who, in describing the facts of Nature, use perpetually the language of intention, and then repudiate the implications of that language when they talk what they call science of philosophy," he overlooks the fact referred to above, that as a general thing "the language of intention" is chosen because none other is available. When we say that running water sifts earthy matter, we may seem to use the language of intention, sifting being a definite action resulting in a definite, and what might look like a purposive, arrangement of the materials subjected thereto; but surely we are not required to attribute intention to the running water. It is difficult to please the duke, however; he declines to respect the opinions of those who use the language of intention without fully accepting all its implica-

tions; and, on the other hand, when Mr. Spencer seeks out the word "equilibration" to express adjustment of structure to function, he is indignant at him for *not* using the language of intention. He declares the word to be "laboriously barbarous and incompetent in its meaning," and altogether a "hideous creation." It always comes round to this in the end that the duke is entirely right and his opponents entirely wrong; and if that gratifying conclusion can not be proved, why, then it is assumed. We wonder whether the critic could not possibly make a personal application of the following judicious observation which we find in his article: "It is one of the infirmities of the human mind that, when it is thoroughly possessed by one idea, it not only sees everything in the light of that idea, but can see nothing that does not lend itself to support the dominant conception." This is precisely the duke's case: he sees nothing that does not to his mind seem to support his dominant conception; and yet, strange to say, after delivering himself of the apothegm, the only application he can make of it is to "the Darwinian school." If ever there was a case in which one might whisper, "*De te fabula narratur*," this seems to be one.

On the subject of rudimentary organs Mr. Spencer's critic indulges in much special pleading. He says we can never be sure "whether these represent organs which have degenerated or organs which are waiting to be completed." Few naturalists, we think, would agree to this. But why should any organ "wait to be completed," unless its completion is dependent on some prolonged natural process? And if a natural process can complete an organ, why might not a natural process have created its first beginnings? The duke seems to us to do here something more illegitimate than anything he charges on the Darwinian school. Confronted with the fact that organs are developed by a series of actions and reactions, of increments and adaptations, each one of which has its place in the chain of physical antecedents and consequents, he deliberately uses the expression "waiting to be completed" for the purpose of creating the impression that natural processes count for nothing, but that the "completion" depends on some kind of divine fiat. If the organs in question are in reality being completed by small improvements in adaptation from generation to generation—which, no doubt, the duke believes—is it honest to speak of them as "waiting to be completed"? We do not speak of a tree "waiting" to grow when it is growing, or of fruit "waiting" to ripen when it is ripening.

Finally, the duke says that a philosophy which is neutral "on the most fundamental of all questions respecting the interpretation of the universe"—the question, namely, "whether the physical forces are the masters or the servants of that house in which we live"—"can not properly be said to be a philosophy at all." It seems to us, on the contrary, that it is just because Mr. Spencer leaves that question unanswered, and shows that it must remain unanswered—at least in any sense that would satisfy the Duke of Argyll—that his system may claim to be a philosophy. His real answer to the question, as we conceive, would be that the physical forces are alternately servants and masters. They are servants as ministering to our mental operations and masters as determining their limits. The powers of mind are servants as being everywhere conditioned by the laws of matter, and they are masters as

being alone interpretative of the universe. We are only landed in blank confusion and hopeless contradiction if we try to assign a positive and undivided supremacy to either mind or matter. No one can doubt that the Duke of Argyll is very sincere in his attachment to pre-Darwinian modes of thought; but it is no less certain that the arguments which he directs against the new philosophy have a singularly unconvincing quality. He is a writer who seems to have exhausted all his intellectual forces in convincing himself: the more carefully we read him, the more the impression grows that he has compassed sea and land, and laid a vast amount of knowledge under contribution, in a strenuous and successful effort to be on the wrong side.

A NEW SOCIAL PROBLEM.

As must have been long apparent to a critical observer of "the tendencies of the times," the department store, to which so many master minds applied themselves during the legislative season just closed, was bound, sooner or later, to rise to the dignity and importance of a new "social problem." It exhibited precisely those traits that appeal so powerfully to the shortsighted philanthropy and superficial knowledge of the "new" social reformer. It required a large concentration of capital, which has come to be regarded as *prima facie* evidence of "social peril." Because of certain economies it was able to effect, it brought about a reduction in prices, which is likewise believed by a well-known school of "uninstructed economists" to be a deplorable evil. Finally, it tended to crowd to the wall smaller concerns dealing in the same class of goods, that found themselves unable to compete with it.

Here were all the elements that go to make up a first-class "social problem." A vivid imagination, inflamed by a deep sympathy with immediate inconvenience and suffering, drew a harrowing picture of the distress to individuals and to society. In the first place, there were the small shopkeepers, high-spirited and independent, driven out of business and compelled to become "mere clerks" under the roof of their merciless rival. In the second place, there were the empty stores scattered all over a city that had been occupied to the advantage of their owners. In the third place, there were the loss of general knowledge of any given business, the confinement of the poor clerks to some special department, and their reduction to the humiliating and paralyzing position of "only cogs in a great piece of commercial machinery." Is it any wonder that such a spectacle moved the hearts of the philanthropists and statesmen in the Legislatures of Missouri, Minnesota, Illinois, and New York? Was it not as plain as a pikestaff that something was wrong? Was it not "the duty of society" to remedy it? Who could be so ignorant and callous as to insist that these questions were absurd —that they applied to the spinning jenny and the power loom as well as to the department store?

Yet such is the fact. The department store is as much a labor-saving device as a steam engine or the telegraph and telephone. One as much as the other is a product of industrial evolution. Like the mediæval fair or the modern market, the department store is a segregation of commodities and of buyers and sellers. Like the perfecting press also, which unites in one machine several distinct processes, such as inking, printing, cutting, and folding, it is an integration under one management of a number of forms of trade carried

on under different managements. It enables capital to gain such generous rewards that it can command executive talents of a far higher order than those content with the profits of a small concern. As a consequence, its management is the most efficient—that is to say, the most economical. Obeying still further the law of evolution, the several departments also fall into the most efficient hands. The subordinates are likewise intrusted with the particular duties they are best fitted for. Thus, from top to bottom, there is an adaptation of means to ends far beyond the reach of an establishment where the management is of a low order of ability and the subordinates unite in their duties a variety of functions. A further gain is had from saving in rents, and from the purchase of goods in large quantities. Besides economy in prices, so important to the multitude of consumers, whose welfare the "new" social reformer seldom considers, there is economy in time and effort. The department store enables them to obtain what they want with a minimum of movement.

In absolute ignorance of the nature and achievements of the immutable law that has called the department store into existence, the "new" social reformer has begun to wrestle, as already stated, with the "problem" it presents. He has begun to repeat the follies that every inventor from Arkwright down has had to face. To be sure, no department store has been sacked or burned; but the legislation proposed as a "remedy" has virtually the same object in view, namely, the destruction of an important labor-saving device. But, most happily, it presents difficulties to its enemies that a mere machine does not offer. Not long ago, when a number of them met in Chicago to propose a solution of the "problem," they could not, as might have been foreseen, agree upon the limit to put upon the kinds of goods the department store should sell. Hardly had the druggist vented his grievance and suggested the rigid exclusion of his goods before the tobacconist arose to protest against the incursion of the druggist into his domain. The grocer filed a like complaint against the butcher, who sells vegetables as well as meat. It was discovered also that the butcher trespassed upon the fishmonger and the oyster dealer. In selling beer and liquor, the grocer was guilty of a similar offense against the saloon keeper. Equally culpable was the tobacconist who sold papers and umbrellas; the shoe dealer who sold trunks and valises; the bookseller who dealt in candy and stationery; and the milliner who sold corsets and toilet articles. In fact, the meeting contained hardly a protestant that did not deal in one or more articles outside of his specialty, and thus present the same "serious problem" that the department store does. Naturally, it broke up without having reached a decision as to how the "problem" should be solved.

Although the same insuperable difficulties confront the "new" social reformer and are not unlikely to prevent him from getting the legislation so generally regarded as the solvent of most troubles, the "problem" of the department store is not insoluble. That is to say, a limit upon its scope is not impossible nor improbable. But the limit will not be drawn by the "wise legislator," but by the law of evolution itself. There is reason to believe that the small store, devoted to special lines of goods, will not succumb altogether. Of certain staple goods and of all goods of a medium or inferior quality, the department store will doubtless retain the monopoly.

But in the highest class of certain goods, such as furs, linens, tailor-made gowns and suits, diamonds and jewelry, porcelain and furniture, the small dealer may be expected to control the retail trade. He alone will possess the high degree of special knowledge and be able to give the personal attention that his business requires. He alone will find it worth his while to cater to the few but wealthy customers that want the best to be had. The department store will find it more profitable, as indeed it does now, to cater to the larger class of customers that care more for cheapness than great excellence. Because of this fact, it is already noticeable, particularly in the inland cities, that specialists have begun to establish themselves, usually taking modest apartments in some large commercial building. Thus, in spite of the department store and without the aid of the "new" social reformer, there will be preserved to the world this class of people with all their "manhood" and "independence," thought to be so important to civilization.

Scientific Literature.

SPECIAL BOOKS.

AMONG the many manuals of architecture Mr. Mathews's book* takes a distinct place. It is a concise history of architectural development through all the various phases of civilization, showing the important modifications produced by location and national life.

Beginning with the time when man longed for something more than mere shelter and strove to make his habitation pleasing to the eye, the author traces the art of construction as it was unfolded in Egypt and Nubia, India and Java, China and Japan. Then, crossing to the Western hemisphere, which is never reached by some writers, he gives an outline of its evolution among the Toltecs, Aztecs, and Incas. Returning to the Old World, he takes up the record of the ruins in western Asia, Chaldea, Assyria, and Persia. Thence the transition is easily made to Greece, Etruria, and Rome; for, although there is an early period of classical architecture—the Pelasgic, whose Cyclopean masonry and corbeled vaulting betray no foreign influence—the efflorescence of Greek art took place many centuries after the Dorian invasion and subsequent to the Persian conquest, when the Greeks had come into contact with many nations and had assimilated whatever was of worth. They borrowed the fluted pillar and molded lintel from the tombs of the Egyptians, but they increased the proportional height of the column until it formed the stately Doric. The colorettes of Nineveh and the Persian capitals possibly suggested the Ionic order; the Greek architect, however, gave it graceful proportion. So, with all the ideas that may be traced to outside sources, the beauty of the transforming touch is clearly recognized, and it is readily acknowledged that for nobility of purpose and an exquisite sense of harmony the architecture of Athens is still unrivaled. "The artist bowed himself to his task with all the unselfishness attendant on an act of worship. To look at Nature, see

* The Story of Architecture. By Charles Thompson Mathews, M. A. New York: D. Appleton & Co. Pp. 468. Price, $3.

only the best, and make it immortal . . . may be justly called the mainspring of all Hellenic thought, taste, and feeling."

Rome was indebted to Etruria and Greece for the elements of her architecture. From the former the arch, vault, and Tuscan order were derived, while the latter contributed the Doric, Ionic, and Corinthian orders. In amphitheaters, aqueducts, and baths she easily surpassed other nations, while in the basilica or law court she furnished a design for Gothic cathedrals and the churches of the Renaissance. Classical ideas prevailed over all countries under Roman rule until the division of the empire. Subsequently the Byzantine style was evolved in the time of Constantine, who spent immense sums in beautifying Byzantium and Constantinople. To this we owe "one of the finest constructive inventions," the pendentive system.

Early Christian architecture was exemplified in the basilicas, which were built in the form of a Latin cross; the introduction of the apse and a great increase of interior decoration were also marked features of the style. This was followed by the round-arched Gothic or Romanesque.

Meanwhile with the Moorish dominion came the Saracenic style, which may be studied in the mosques and tombs of the East and in the palaces of Spain. Although contributing no new principle, "the world owes it a debt of gratitude for its ornamental exuberance controlled by good taste." Interiors were made exquisite with fretwork, mosaics, and jeweled inlays, while minarets and domes of graceful proportions were beautified with tiles "belonging to a lost ceramic art."

Gothic architecture is considered by Mr. Mathews in its two developments, ecclesiastical and secular, the different periods and characteristics being very carefully and clearly explained.

Two chapters are devoted to the Renaissance, which the author has treated in more detail in another volume, and the book concludes with an examination of American architecture. The high buildings of the present day are relegated to the province of engineering; most of them are "attenuated monstrosities." However, "when a whole block is devoted to such a structure, and the design is treated pyramidally, the result may be stately and imposing."

The work is amply illustrated, and a bibliography, index, and glossary add much to its convenience and value.

In his recent work on economics Prof. *H. J. Davenport* makes large use of the suggestive mode of imparting knowledge.* He asks suggestive questions at the beginning of each chapter, review questions at the end, and topical questions in the margins. In preparing the book he has evidently had college students in mind for whom the instructor would be available to supplement the text with lectures and answers to questions. The vigorous thinker might dispense with such aid, but the average learner is very often left by suggestive teaching encumbered with many hazy ideas and exasperated with many unanswered queries. Our author generally avoids short and precise definitions. He seeks to give an understanding of the nature of utility, wealth, value, capital, etc., by leading the reader to look at each from different points of view and thus to build up in his mind

* Outlines of Economic Theory. By Herbert Joseph Davenport. New York: The Macmillan Co. Pp. 381, 8vo. Price, $2.

a composite picture, as it were, of the thing or quality. In discussing wages and profits he represents these two terms as essentially identical and makes compensation for risk a separate thing. They are paid with the residue of production after the service of land and capital are requited. The wage-earner's assurance, he says, of receiving the approximate value of his product rests solely upon the effectiveness of competition among employers. His wage is, however, guaranteed from falling very low by his own power of producing directly for the market. This in turn is limited by his lack of capital. Prof. Davenport accounts for international trade like exchanges between individuals on the theory that each party finds he can satisfy his desires at less sacrifice by making one kind of goods and exchanging the surplus for the surplus of the different kind of goods produced by the other party. In measuring the "sacrifice" or cost, however, other than material things often have weight. The latter portion of the work is devoted to practical economic questions of the day. Here he discusses the competitive system and the remedy which is claimed to lie in socialism. He sees a promising field of usefulness for trades unions in establishing emergency workshops between which exchanges could take place by barter. Other topics that receive attention are State ownership of transportation and other industries, the social function of the rich, race improvement, the economic influence of fashion, taxation, various labor topics, and the currency. His general method of treating these matters is to point out the conflicting considerations that bear upon them, but without assuming to declare which outweighs the other. If the work resembled many others, in presenting one view of each topic as the only correct one, it would be much easier to describe, but we can not say that it would be as useful to its readers.

While fully appreciating the value of Froebel's kindergarten work, Mr. *Hughes* wishes teachers to realize that Froebel laid down principles of the greatest worth in more advanced education.* He has accordingly, in this volume, set forth the philosophy of Froebel's system, giving a chapter to each of its most prominent features. Comparing Froebel with Pestalozzi and Herbart, Mr. Hughes says: "Pestalozzi was instinctive and inspirational, Froebel was philosophical and investigative. . . . Pestalozzi's pupils were reproductive; Froebel's were creative. . . . Herbart studied the child to mold it; Froebel studied it to guide it in its growth. . . . Herbart saw the need of control much more clearly than the need of freedom; Froebel saw the harmony between freedom and control." Froebel's fundamental law, according to our author, is that of unity or inner connection. "He saw the unity between knowing, feeling, and willing, between analysis and synthesis, between thought and life. He saw the unity or inner connection of all created things so clearly, that he made the reconciliation of opposites an important element of his system. He believed this law of unity, inner connection, or vital interrelationship to be universal, and made it the fundamental law and the ultimate aim of all true educational effort." The most fruitful of Froebel's principles was that of self-activity on the part of the child—"the spontaneous effort of the child to make manifest to itself and others the inner conceptions and operations of its own mind." This is

* Froebel's Education Laws for All Teachers. By James L. Hughes. International Education Series, Vol. XLI. New York: D. Appleton & Co. Pp. 296, 12mo. Price, $1.50.

very different from action initiated by the teacher. While he insisted that the child's individuality should be respected, he did not advocate giving the child license to do wrong. The teacher should be able to transfer the child's interest from what is wrong to what is right. He wished to banish coercion; he "would have the control of the mother and kindergarten so thoroughly in harmony with the spontaneity of the child as not to be felt by it." He fully recognized the educational value of play, and was the first to use it systematically as a means of mental and moral training. His profound sense of interrelationships made him a pioneer in the correlation of studies. The same characteristic caused him to look beyond mere perception on the part of the learner, and to insist on apperception. Froebel was an evolutionist before Spencer and Darwin, and he was the first to make systematic use of manual training in distinction from industrial training. The supreme aim of his educational system is character-building, and "he applied precisely the same laws to the revelation of ideals of right, justice, duty, and will that he applied in the general development of the child." In stating Froebel's views Mr. Hughes makes large use of quotations from Froebel's Education of Man and Autobiography, and from the Baroness von Marenholz-Bülow's Reminiscences of Froebel. The book is eminently one to stimulate the teacher's growth.

GENERAL NOTICES.

In *Telepathy and the Subliminal Self* we have an attempt to put certain occult phenomena on a scientific basis.* The author, rejecting all ideas of the supernatural, approaches his subject from the point of view of a scientific observer who does not speculate with the intangible, but who has a definite theory, that shall account for certain mysterious occurrences. The subjects he takes up are Telepathy, Mesmerism and Hypnotism, Clairvoyance, Double or Multiplex Personality, Somnambulism, Dreams, Automatism, Planchette, Crystal-gazing, and Phantasms. He explains most of these phenomena by means of the subliminal self. This mysterious personality lies hidden away deep down below our ordinary self, coming to the surface only on special occasions, or when called up without our knowledge by the hypnotizer or mesmerist. And it does not seem to be given to every one thus to project this inner being into the outer world of sense; although apparently this other personality is latent in us all, only the "sensitive" can manifest it. The author deduces his theory from a number of experiments and "experiences" recorded by the English Society for Psychical Research, the French therapeutic hypnotists of La Salpêtière, and of Nancy, and others, both physicians and laymen. The chapters on Double or Multiplex Personality and Natural Somnambulism give a number of cases in which the subliminal self stands plainly revealed. Some instances, however, might very well be classed under temporary aberration of mind, as for example that of Ansel Bourne the evangelist, who, leaving his home in Rhode Island, went to Norristown, Pa., and after keeping store there for two months under the name of A. J. Brown, suddenly awoke to find himself in a strange place. One of the most curious chapters in the book is that on Crystal-gazing, a species of divination somewhat akin to clairvoyance. The chapters on Phantasms sustain perhaps most fully the author's theory of the subliminal self. He does not pretend to go over the whole ground of psychic phenomena, leaving untouched, for example, the subject of the return of the departed, and other spiritualistic manifestations. But "confining ourselves within the limits assigned, if the series of alleged facts which has been presented in the preceding chapters be true,

* Telepathy and the Subliminal Self. An Account of Recent Investigations regarding Hypnotism, Automatism, Dreams, Phantasms, and Related Phenomena. By R. Osgood Mason, A. M., M. D. New York: Henry Holt and Company. Pp. 343, 12mo. Price, $1.50.

then we are in the presence of a momentous reality which, for importance and value, has not been exceeded, if indeed it has been approached, by any of the discoveries of modern times." However far the author's theories and enthusiasms may carry him, the book is an honest effort to explain some more or less tangible occurrences in a rationalistic manner, free from superstitious cant. It is a readable and interesting contribution to the literature of the new psychology.

Two out of the forty-five volumes of the *Library of the World's Best Literature* * have come to hand. This work, unique in scope and character, aims to do for literature what the Encyclopædia Britannica has done for the arts and sciences in general—to give a survey of what the best poets, writers, and thinkers of all ages have thought and felt and expressed in artistic form, from the records indelibly stamped on the baked brick of the Assyrians, the characters traced on the papyrus of the Egyptians and Chinese, the pergamena of the Greeks and Romans, the vellum of the mediæval monks, even down to the type-written manuscript of the present day. The plan, in the words of the editor in chief, Mr. Charles Dudley Warner, "is simple and yet it is novel. In its distinctive features it differs from any compilation that has yet been made. Its main purpose is to present to American households a mass of good reading. But it goes much beyond this; for in selecting this reading it draws upon all literatures of all times and of every race, and thus becomes a conspectus of the thought and intellectual evolution of man from the beginning. Another and scarcely less important purpose is the interpretation of this literature in essays by scholars and authors competent to speak with authority." Many of the best critics, both in this country and abroad, have taken part in the making of the work. Among the American contributors of note to the first two volumes may be named Prof. Toy, of Harvard, who writes on Accadian, Babylonian, and Assyrian Literature; Mr. H. W. Mabie, on Addison; Dr. H. T. Peck, on Æsop and Alciphron; Mr. R. Burton, on Amiel; Prof. E. S. Holden, on Arago; Rabbi Gottheil, on the Arabian Nights and Arabic Literature; and Prof. Woodberry, on Matthew Arnold. The selections thus introduced by critical and biographical essays, and representing the author at his best, are carefully chosen with reference not only to their literary quality, but also to their interest as reading matter, for "the work aims to suit a great variety of tastes, and thus to commend itself as a household companion for any mood and any hour." The names are arranged alphabetically, for ready reference. The volumes are handsomely bound in half morocco, with clear print on good paper, and illustrated with portraits of the authors, colored plates, and photogravures.

Prof. *Baldwin's* book on *School Management* is devoted to the practical side fo the subject.* It takes up the several divisions of educational work systematically, and gives helpful advice and suggestions on a vast number of topics in each division. Pupil improvement is the keynote of the work, and the author aims to show how this can be secured through better educational conditions and facilities, better school and college organization and correlation, and the most efficient methods of teaching, and how school government and class management can be made educative. Among the elements of educative governing power he names, first, character. "Be what you wish your pupils to become," he says. Next he places culture, and charges the teacher to "cherish the spirit of mastery and broad culture." Other elements whose importance he explains are pupil insight, teaching power, heart power, will power, system, tact, and bearing. Of the possible incentives to school work he points out which are low motives, which higher, and which the best. He shows how school regulations can have an educative effect, and what punishments operate to help and what to harm the pupil. In other chapters he gives advice as to school hygiene, means and methods of administration, methods of teaching the usual school studies, ways of conducting partly graded schools, etc. He is a strong advocate of oral teach-

* A Library of the World's Best Literature, Ancient and Modern. In 45 volumes. New York: The International Society. Price, cloth, $3 a volume; half morocco, $4 a volume.

* School Management and School Methods. By Joseph Baldwin. International Education Series, Vol. XL. New York: D. Appleton & Co. Pp. 395, 12mo. Price, $1.50.

ing, by which he means something like the Socratic method, with the use of objects for some studies. Prof. Baldwin's teachings are everywhere positive and emphatic, and he ignores any possible difference of opinion on such subjects as corporal punishment, free text-books, and coeducation. The book is intended to be used for systematic study by classes of teachers, and each chapter is accordingly divided into sections and subdivided into paragraphs, each with a number and a heading. There is also a syllabus to each chapter, and a list of topical questions at the end of the volume.

Prof. *Wiley* has brought to a close his carefully prepared treatise on *Agricultural Analysis* with a volume devoted to agricultural products.* The first chapter relates to methods of preparing samples by grinding, drying, incineration, and extraction. Twenty-six forms of apparatus for these operations are here figured. The first group of substances for which processes of analysis are given consists of the sugars and starches. The specific gravity, the polariscopic, and the reduction methods for sugar analysis are each represented by a number of processes. The author has not undertaken to select the best practice for dealing with every problem, as he has not been writing solely for students, but more for trained analysts who are competent to select for themselves from several carefully described modes. A variety of miscellaneous processes for sugar analysis are also described. The determination of starch requires less space, and from this the author passes to methods for separating and determining sugar, starch, and other carbohydrates in crude or manufactured agricultural products. The fats and oils form the next large group of substances treated, and considerable attention is given to their physical properties, as well as to their chemical behavior. Methods of estimating nitrogenous bodies follow; dairy products have a section by themselves, and a considerable number of substances are grouped as miscellaneous. These include cereals, fodders, meats, fruits, vegetables, tannins, tobacco, tea, coffee, and fermented beverages. In dealing with meats several methods of artificial digestion and of determining nutritive values are described. The volume is indexed, and is illustrated with one hundred and twenty-five figures of apparatus. A list of authorities cited is given at the end of each division of the work.

In his *Laboratory Practice for Beginners in Botany*, Prof. *William A. Setchell* has furnished a guide for the application of the laboratory method to the study of plants (Macmillan, 90 cents). He takes up the seed first, because "it is not only readily obtained, readily studied, and its meaning clear, but it is also one of the most convenient starting points for a study of the life history." His first directions will indicate his method. "Take the ripened pod of a bean plant and, splitting it open, notice: 1. That the seeds (beans) are attached along one edge of each valve (or half) of the pod. 2. That each bean is attached to the pod by a short stalk, the *funiculus*. 3. Make a sketch of a valve of the bean pod with its inclosed beans, representing and labeling the parts." Drawing is a constant requirement throughout the course. In the advanced lessons questions are asked which it is not practicable to answer otherwise than from consulting books. There is a brief appendix of suggestions to students and one more extended of suggestions to teachers, in which reading for each chapter is specified and various directions as to material and details of instruction are given. Although the author says that his book is intended for the higher grades of primary schools or for secondary schools, he has apparently made no effort to keep his language within the vocabulary understood by children, hence we doubt that the book would be available below the secondary grade. There are no illustrations.

Robert the Bruce and the Struggle for Scottish Independence, by Sir *Herbert Maxwell*, Bart. (New York: G. P. Putnam's Sons, 1897, $1.50), is one of the scholarly volumes of the Heroes of the Nations Series. It deals with the making of Scotland. The first five chapters give a short survey of the country up to the year 1305, a period of internal discords, and feuds with England because of the latter's

* Principles and Practice of Agricultural Analysis. Vol. III. By Harvey W. Wiley. Easton, Pa.: Chemical Publishing Company. Pp. 666, 8vo. Price, $3.75; complete work, $9.50.

claim to the overlordship. The greater portion of the book recounts the deeds of Robert the Bruce, the national hero. His coronation as King of Scots, in 1306, marked an epoch in Scottish history. Become king of a country that was claimed by the English Edward, and surrounded by only a small band of faithful followers, Bruce virtually had to conquer his realm foot by foot, until the decisive battle of Bannockburn, in 1314, forced the English to acknowledge his sovereignty. The many exciting adventures of the landless king, and his daring and personal bravery, are well set forth in some of the most interesting chapters of the book.

Among the papers submitted in competition for the Hodgkins Fund prizes and published by the Smithsonian Institution is one on *Atmospheric Actinometry*, by *E. Duclaux*. The chemical radiations of the sun do not behave within our atmosphere in the same way as the heat and light rays. This is indicated by the differing effects on the photographer's plate on days equally luminous, and by the rapid progress of vegetation in high latitudes as compared with temperate regions. The investigations which M. Duclaux describes are based upon determinations of the oxidation of solutions of oxalic acid exposed to the sunshine under a wide variety of conditions.

In the introduction to *The Story of the Birds*, by *James Newton Baskett*, M. A., Associate Member of the American Ornithological Union (New York: D. Appleton and Company, 1897, 65 cents), one of Appletons' Home-Reading Books, the editor of the series, Dr. W. T. Harris, points out the two movements of the new education—original observation and verifying by experiment on the part of the pupil, and systematic home reading to supplement class-room instruction. "A library of home reading should contain books that stimulate to self-activity and arouse the spirit of inquiry. The books should treat of methods of discovery and evolution. All Nature is unified by the discovery of the law of evolution." In keeping with the aims here set forth, The Story of the Birds gives a brief account of the evolution of the bird, as far as such can be traced by means of the present characteristics of the feathered race. Beginning with the bird's fore leg, popularly known as the wing, which is an important factor in determining its past history, the author goes on to the discussion of the bird's raiment, its outer wraps and its underwear, its "frills and furbelows." We have chapters devoted to the wooing and mating of birds, to nest-building and nesting habits, to birds' eggs and the rearing of the young. Various habits of grown-up birds are touched upon, their expedients in getting a living, their tools and tasks, the way they go to bed, and their manner of travel. In the last two chapters hints are given for recognizing and classifying the different species. Scientifically accurate, yet free from technicalities forbidding to the uninitiated, the book, written in a pleasing style, recommends itself not only to the young student, but also to the general reader who, as a lover of birds, wants more than a passing acquaintance with them. It is profusely illustrated. An analysis of the chapters, with study hints, and an index, add to its usefulness.

In a pamphlet entitled *A New Dairy Industry* a process for preparing sterilized milk for infants is described by *James Fred. Sarg* (the author, Kempsville, Va., 80 cents). Mr. Sarg writes for the farmer, who, he says, is best situated for preparing a suitable infants' milk and should have the profit of the industry. Whether discoursing of the operation of milking, the mortality of infants, or the details and apparatus of the process that he describes, Mr. Sarg writes with vigor and an evident mastery of his subject. His pamphlet is illustrated with figures of machines and other appliances.

An inaugural discourse before the Royal Academy of Sciences of Havana, on the study of spectroscopy (*Introducción al Estudio de la Espectroscopia*), by Dr. Gastón Alonso Cuadrado, of the medical corps of the Spanish army, presents a clear and carefully elaborate summary of the theory and properties of light as illustrated by the latest discoveries, including a brief account of the Röntgen rays.

Rules for Regulating Nomenclature in Entomological Work, compiled by *Lord Walsingham* and *John Hartley Durrant*, of Merton Hall, Thetford, England, and published by Longmans & Co. (20 cents), have been prepared with a view to securing a

strict application of the law of priority. One of the objects of the authors has been to define a method by which the recognition of antecedent work can be consistently secured. They propose that this rule be designated as "Merton rules" for convenience of reference.

Convinced that physical science awaits its next greatest elucidations from the side of biology, Dr. *Ernst Mach* has made from time to time various researches on sensation, the results of which he states in a volume under the title *Contributions to the Analysis of the Sensations* (Open Court Publishing Company, $1.25). He here discusses the space sensations of the eye in connection with the innervation of that organ and the physiological aspects of sensations of time and sensations of tone. The conclusions which he has arrived at on these topics show, he affirms, that "there is no rift between the psychical and the physical, no *within* and *without*, no *sensation* to which an outward, different *thing* corresponds. There is but *one kind of elements*, out of which this supposititious within and without is formed."

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Fragments of Science.

Dr. Ebenezer Emmons and the Olenellus.—During the geological survey of the State of New York which, commenced in 1836, was almost the first of the geological surveys that were entered upon and properly prosecuted in the United States, there was a marked difference of opinion between Prof. Ebenezer Emmons, of Williams College, who had charge of the portion of the survey that embraced the rocks of western Massachusetts and the upper waters of the Hudson, and his associate geologists, which finally terminated in a bitter personal antagonism and almost social ostracism of Dr. Emmons. The point at issue was mainly the relationship in respect to position and age of the rocks in question, especially those typified by the strata of Greylock Mountain and the Hoosic Valley. The position taken by the majority of the associate geologists on the survey was that the so-called Silurian system of rocks constituted the basis of the fossiliferous rocks of New York and inferentially of the whole country, and that the so-called "Potsdam sandstone" was the lowest fossiliferous member of this system, and in fact marked the dawn of life upon the planet. Dr. Emmons, on the contrary, claimed that beneath the oldest member of the Silurian system there was an older and extensively developed system of fossiliferous rocks, to which he gave the name "Taconic," and exhibited an entirely new and characteristic fossil not before recognized or described, and which received the name of "Olenellus." For all this Dr. Emmons received little or no credit, and among geologists was regarded as visionary and something of a humbug. But time has at last brought its revenges, for, at the last meeting of the British Association for the Advancement of Science (Liverpool, September, 1896), Mr. J. E. Marr, F. R. S., President of the Geological Section, in an address reviewing the recent progress in this department of science, took occasion to speak of the "Olenellus"—whose first discovery he attributed to Dr. Emmons—as characterizing a zone of life in rocks much older than the Silurian system, and as "furnishing us with a datum line from which we can work backward," and possibly prove the existence "of a fauna of a date anterior to the formation of the Olenellus beds." So that Dr. Emmons, in place of being wrong in his observations and deductions in 1845, did really find the fossil he described, and rightly located the rock containing it in the geological horizon; and thus was entitled to take the lead at that time over all his American and European colleagues.

Koch's Latest Tuberculin.—Since the premature announcement of Dr. Koch's consumption cure, some six years ago, the doc-

tor has been steadily at work endeavoring to perfect his method, and it is now announced that he has succeeded in eliminating those irritating substances which were so troublesome in the early preparations. From his observations Koch concluded that the affected patient gradually acquired a degree of immunity through the absorption of certain constituents of the bacilli themselves. This immunizing, however, usually occurs too late in the disease to save the patient. In order to collect these substances, whatever they may be, he dries and triturates the dead bodies of the bacilli, and from the resultant powder makes two extracts. The first of these is opalescent, and is practically identical with his original serum. He calls it tuberculin O (TO). The remaining sediment is again dried, digested with water, and then centrifuged, and this is continued until the water is perfectly clear. These later extracts contain the essential immunizing principle which he calls tuberculin R (TR), and with which such encouraging results are said to have been obtained.

Some Notes on a Dust Storm.—Apropos of our recent article on Dust Storms, we have received the following item from Mr. W. S. Jackman: "On the 19th of February, 1896 (*Ash Wednesday*, by eternal fitness), a remarkable dust storm descended upon the city of Chicago. As the ground had been completely covered with snow to the depth of several inches a day or two previous, it was an easy matter to form some estimate of the quantity of dust that fell. The storm began in the evening and lasted several hours. The next morning, by selecting suitable open areas that were likely to be free from eddies and local currents, an average per square yard of 1·34 ounces of dust was obtained. This was gathered by scraping up the snow to the depth the dust had penetrated—about one inch—and, after melting it, the water was evaporated and the dust dried. The amount thus collected measured 2·45 cubic inches. At this rate the quantity of dust deposited upon a square mile would be about 129·6 tons; the volume would be on the same area 4,352 cubic feet, equal to a pile about thirty-four feet long, sixteen feet wide, and eight feet deep. On being strongly heated in a clay crucible the dust turned reddish brown and lost twelve per cent of its weight. The microscope showed it to be largely composed of irregular and rounded quartz grains. As the storm began after dark, people who were unfortunate enough to be caught in it were at a loss for a time to know just what was the matter. In many instances nothing unusual was suspected until, entering their homes, their smeared and blackened countenances called forth an unwontedly hilarious greeting. After the snow melted, in many instances the sidewalks were so covered with the slimy mud as to need scraping and washing. The storm seemed to come from the northwest, and was accompanied by a moderate gale."

The Law of Mississippi Floods.—An important point in Mr. James L. Greenleaf's study in the Engineering Magazine of the Times and Causes of Western Floods is the topographical division of the country drained by the Mississippi into several large water sheds, covering a total area of 1,259,000 square miles. Although this topographical division has been wrought by natural causes, the consideration of the water sheds must be combined with that of climatic areas for the purposes of the present study. All the rivers tributary to the Mississippi show a decided tendency to low water in the autumn, the southern waters beginning to fall from a high stage in June and the northern in July. All begin to rise from low water in winter—the southern tributaries earlier, and the northern ones later. Two freshets occur during the year in each of the large tributary basins. The coincidence of the highest stage in more than two of the large branches is extremely rare, and hence it is an exception for the main river to be subjected to the enormously congested state which would otherwise result. The varying stages of the Mississippi accurately reflect the fluctuations of rainfall and of temperature which occur upon its tributary basins, and these are followed in detail in the author's paper. The Mississippi being virtually created by the union near one point of three large rivers—the Ohio, the Missouri, and the upper Mississippi—these three branches, of which the Ohio is regarded as the most important, naturally stamp their characteristics upon it to a very marked de-

gree, and it bears these features through the entire course to the Gulf. The large tributaries farther south modify but can not control their overwhelming influence. The two periods of flood characteristic of each of these large tributaries have an important bearing upon the continuance of high water in the main river, pouring their floods in one after the other as the force of the preceding flood is beginning to be spent, so that the tendency is for the main river to flow in strong volume until well into the summer. The river is a result; its tributaries are the cause. Viewed broadly, a general similarity of behavior is observed; yet each feeder of the main river has its special cycle of alternations between high and low water; each great line of drainage has its special feature of flow. Were the secondary watercourses followed, the vast Mississippi water shed would be seen covered by countless brooks and rivulets, each affected by local conditions, yet all obeying a few fundamental laws, "which gather the waters as in the hollow of the hand and pour them through a single channel to the sea."

The Turbinia.—In a recent issue of Industries and Iron is a detailed description of the Turbinia, the vessel which recently attained the highest velocity ever reached by a steam vessel, an average of 32¾ knots on the measured mile. As her name suggests, she is fitted with steam turbines instead of the ordinary form of engine. The Turbinia was built by a syndicate formed especially for the purpose of testing the application of the compound steam turbine to marine propulsion. She is 100 feet in length, 9 feet beam, and 44½ tons displacement. The original turbine fitted in her was designed to develop upward of 1,500 actual horse power at a speed of 2,500 revolutions per minute. The boiler is of the water-tube type, for 225 pounds per square inch working pressure. The hull is built of steel plates, varying in thickness from $\frac{1}{16}$ to $\frac{3}{16}$ of an inch. A curious difficulty was encountered in the early trials. It was noticed that a great deal of power was being lost somewhere, and it finally turned out that, owing to the high speed of the propeller, what is known as cavitation was produced—that is, the screw tended to scoop out a hole in the water and run in this, thus using up a part of the energy simply in maintaining this cavity. This difficulty has been, to some extent, overcome by altering the pitch of the blades, but it is believed that further experimentation will result in overcoming this fault more completely, and hence make a still higher rate of speed possible.

German Colonies for Unemployed Workmen.—The first of the German Arbeiter Kolonie, or refuges for workmen out of employment, one of which has been described in the Atlantic Monthly by Mr. Josiah Flynt, was established by Pastor von Bodelschwingh at Bielefeld, Westphalia, about 1882. There are now twenty-seven such colonies in Germany, where men able and willing to work may go, and at least pay their way till some more profitable labor is found. Connected with them is an estate near Berlin, where men who have proved deserving may acquire a piece of land and eventually set up homes of their own. Applicants for help must promise to stay in the colony at least four weeks, and have the privilege of staying longer if no work has been found for them outside; while the managers are on the lookout for work for them, in order that they may go and other out-of-works may take their place. The colonies are supported by contributions and the proceeds of the work of the colonists. Mr. Flynt applied at the Berlin colony at Tegel, and, on complying with the conditions required, was assigned to a section and set to making straw cases for wine bottles. He was expected to work to the best of his ability and to show respect to the officials—a Hausvater and a foreman, the only outsiders connected with the institution. The day was spent according to a prescribed routine, beginning at five o'clock in the morning and ending at nine o'clock at night, while Sunday was given to church and rest. Every man received a mark, or twenty-five cents, a day, and some, working by the piece or at special work, made a mark and a half. Out of these earnings, eighteen cents a day were taken for food and lodging. Several men had credit in the colony treasury. The food was simple but abundant, and the beds were fairly comfortable. A store was opened on Saturday afternoons, where the colonists

could buy tobacco and various useful little things. Newcomers were confidentially exhorted and admonished on Sunday afternoons by the pastor. Forty-nine men were in the colony during Mr. Flynt's stay. In winter there are more than three hundred. The colonies are believed to be useful in distinguishing the deserving unemployed from the undeserving, and helpful to the former.

Diffusion of an Ancient Symbol.—The *swastika*—a design resembling two Z's, normal or reversed, so arranged as to cross one another—is described and studied as "the earliest known symbol" in a paper by Thomas Wilson in the Proceedings of the United States National Museum. It appears in various shapes, derived from the original, and is the parent of various scroll forms and ornaments. Its origin and original bearing or application are lost in the darkness of remote antiquity. It denotes something good, and is an ornament. It is found in the far East and the classical East, in all the cities of Troy, in Egypt, Algeria, and Ashantee, in the ancient Grecian countries, in western Europe from the bronze age down, on ancient coins, in prehistoric America, and among the North American Indians. Allied to it are meanders, ogees, and spirals; and associated with it are various prehistoric objects in both hemispheres. In America, the swastika of the mound builders, or of the oldest civilization we know here, is similar in every respect, except material, to that of the still living Navajo and Pueblo Indians. The two curious facts are emphasized that the swastika had an existence in America prior to any historic knowledge we have of communication between the two hemispheres; and that it is continued in America, and used at the present day, while the knowledge of it has long since died out in Europe. Mr. Wilson's chief study is to find how this symbol was carried from one region to another. While the theory that like features of life originate naturally at like stages in the development of different peoples, and the one that they are carried by migrating hordes, may both be true to a certain extent, neither should be insisted upon as exclusive. Mr. Wilson maintains that the swastika was carried, as some other customs may have been, by teaching, or by the transmission of the idea from one country to another—much in the same way as Greek art and architecture have come down to us—rather than by independent invention or by migration of peoples.

Richard Hakluyt.—The Hakluyt Society has recently celebrated in London the fiftieth anniversary of its work in publishing volumes, usually containing the texts of travelers and voyagers in all parts of the world, which were previously not known to the public. It is named, Sir Clements Markham says, after Richard Hakluyt, who was born in 1553, acquired a love of geography from an uncle of the same name, and assiduously sought and read every narrative of adventure he could procure, mastering six foreign languages in order to be able to do so. He strove to remedy the ignorance of seamen of the scientific branch of their profession, and to supply the absence of records for want of which important voyages and travels were allowed to fall into oblivion, with a measure of success that has given him rank among the benefactors of their country. He was irrepressible in seeking new information. He rode two hundred miles to have an interview with the last survivor of Master Hose's Expedition to America in 1536. He saved numerous journals and narratives from destruction, and the deeds they record from oblivion. His work gave a stimulus to colonial and narrative enterprise, and inspired literature. Shakespeare owed much to Principal Navigators, his chief book. As the years passed on, he, according to his own quaint language, continued "to wade still further and further in the sweat studie of the historie of cosmographie," and achieved his great task, which was "to incorporate into one body the torn and scattered limbs of our ancient and late navigations by sea." He declared "geography and chronology to be the sun and moon, the right eye and the left, of all history." When he died, November 23, 1616, he was Archdeacon of Westminster, and had reached his sixty-fourth year.

Primitive Traveling.—Of the motives and lengths of the journeys of primitive man Mr. O. T. Mason observes, in his monograph on Primitive Travel and Transportation, that birds of passage made formerly longer jour-

neys than men, and the length of their migrations in time and distance was equaled, perhaps, by those of fishes and marine animals. The simple motives that governed these movements were the same as constituted the incentive to human movements over the earth. The coming and going of birds and marine creatures are likewise the occasion of an enormous amount of human bustle and running about. Most of the domestication of animals is prompted by a desire to have them at our doors, and to make us independent of their migrations. Land animals, as well as birds and sea animals, were often obliged by natural conditions to travel great distances, and men followed them in order to live upon them. In every tribe there are stories of travelers who made long voyages and returned. Dr. Boas says that the myths of the northwest coast of America point across the Pacific. Besides the traditions that fix upon the present habitat as the primal home, there is a class of migration myths. The perfection of devices also prolongs travel. The East Greenlanders journey around to West Greenland to get snuff, and will consume four years in a single excursion there and back, often, according to Nansen, remaining no longer than an hour at the trading station before taking up their homeward march. The Manchus and Manyarg, who navigate the Sungari River, spend from eight days to a month, according to the destination, in their journeys; the Turki, near East Cape, from four to six months. According to Seton Karr, the tribes of northwest British Columbia were afraid to quit their tribal territory, but now Indians are willing to accompany the white man through regions that are as strange and unknown to them as to him. The extent and direction of aboriginal journeys have been in some places cut off, and in others greatly stimulated, by contact with the Caucasian race.

Utilization of Wind Power.—A summary of the conclusions reached by M. Maximilian Plessuer from a study of the economies of wind as a source of power is given by M. Henry de Varigny in a paper on Air and Life, published by the Smithsonian Institution. The irregularity of the wind forms the chief objection to placing reliance upon it, but much depends upon localities. There are places and large regions where it is fairly regular. It seldom fails at the seashore, and the trade winds are nearly constant; while in most parts of the globe it becomes more regular as the altitude increases. Hence, upon the whole, a considerable part of the world is well suited for investigations upon the best methods of deriving power from the winds. The first requisites of a wind-power machine are some sort of a motor driven by the wind, and an accumulator to store the energy and yield it at the required moment. Dismissing the old windmill and the æolian wheel as not fully coming up to the mark, M. Plessuer turns to sails as affording a possible solution of the problem. "The utilization of the power of the winds," he writes, "and its transformation into mechanical work are only possible by means of sailing vehicles, driven by wind upon a circular railway, the power generated by such rotation being transmitted to an axle and thence to machinery." On this railway a circular train, made of small cars coupled together, each carrying a mast and two sails at right angles with each other, is driven by the wind. The sails are automatically trimmed, and automatically also they expand or contract, or rather take in the wind or withdraw from it. As long as the wind blows the train continues rotating, and if it is connected with a central axle the latter may work dynamos and charge electrical accumulators. A similar apparatus might be arranged in water, boats taking the place of the cars, and, since the wind power is transformed into electricity, the latter may be stored and kept in reserve, or transferred to a distance to perform ten, twenty, or fifty miles away any work that may be required.

"Our Friends the Monkeys."—Why, asks M. Paul Mégnin in La Nature, should we not call monkeys our friends? They have been calumniated and had all sorts of evil qualities attributed to them, because when we make pets of them we encourage and cultivate their odd traits, and spoil them as children are spoiled. All monkeys have not equal degrees of intelligence, but most of them are capable of a development equal to if not above that possible to any other

animals. They love to learn, and the imitative instinct natural to them permits them to execute all sorts of feats with agility. They learn tricks more readily than dogs, and, although not manifesting so hearty good will toward the public, execute them with marvelous agility and grace. At Hagenbeck's establishment in Hamburg, where two hundred monkeys enjoy complete liberty of play in the great rotunda, they are given multitudes of children's toys, balls, hoops, wheelbarrows, joiner's benches, etc., and learn to manage them all without any one showing them how. In the center of the rotunda is an immense grain hopper, from which the seeds, corn, walnuts, chestnuts, apple quarters, etc., run into a trough when a wheel at the top is turned. The management of this hopper did not have to be explained to our friends the monkeys. While one of them turns the wheel, the others, sitting around the trough, enjoy the delicacies as they come down, till the one at the wheel, thinking his turn has come, stops, gives the signal for some one to take his place, and comes down to get his share. What other animals are capable of so intelligent an initiative?

Minute Earthquakes.—Very delicate experiments have been instituted by Prof. John Milne to determine the stress inflicted upon the earth's crust by small, even minute, disturbances, whether local earthquakes on a small scale, faint echoes of more violent distant disturbances, those arising from meteorological causes—which are receiving special attention—or even those which are due to the falling of rain and to dew. A shower of rain or a deposit of dew represents a considerable load on the soil, which may perhaps be regarded, in the first instance, as uniformly distributed, but which will probably, because of inequalities in evaporation, not remain so long. The ground on the east side of a building will be more quickly dried than that on the north; the dew on the east side will evaporate before that on the west side, and so on. Thus there will be bending stresses in the soil tending to tilt buildings or piers for instruments that have not deep-laid foundations. Tilts due to rainfall would be irregular; those arising from dew would show a diurnal period. The inquiry is made whether these tilts are large enough to affect astronomical observations. Diurnal oscillations of several sections of an arc have been detected by seismographs in Japan, which Prof. Milne attributes to the evaporation of dew. At the observatory of the University of Oxford a disposable weight, consisting of a crowd of human beings, was utilized. Formed into a solid square, they were marched back and forth, to and from the observatory wall. They were then spread out so that they only touched by the finger tips; and again so as to cover four times the space of that formation. This was supposed to represent the evaporation effect. Seventy-six persons were thus employed, and their marching back and forth produced an appreciable bending of the earth. As an aid to his research, Prof. Milne has had a horizontal pendulum set up in the Isle of Wight, in order to obtain a continuous automatic record of such disturbances as are there manifested.

Improvement in Antitoxine-Making.—In a recent number of the *Archives des Sciences Biologiques* issued by the Imperial Institute of Experimental Medicine at St. Petersburg is an important announcement by Dr. Smirnow, describing a new method of obtaining diphtheria antitoxine. Hitherto the preparation of the antitoxine has not only involved great expense, but also much time, several months oftentimes. The new method announced by Dr. Smirnow institutes a great saving in both time and expense, and consists simply of electrolyzing a virulent diphtheria broth culture, which is then found to contain an antitoxine of great power and efficacy. Dr. Smirnow states that a dog weighing from eighteen to twenty pounds, inoculated subcutaneously with 0·5 cubic centimetre of a virulent diphtheria broth culture, usually dies in two or two and a half days. If, however, even one day after inoculation, treatment with the new serum is begun, from three to five cubic centimetres of the latter suffice to save the animal.

Maxims for the Holiday.—The first requisite to the complete enjoyment of a holiday, as laid down by the London Lancet, is to have earned it. Only a true workman thoroughly enjoys his season of rest, while the idler, the trifler, the man of pleasure,

knows little of its delights, for it brings him no change. It is well, in arranging for the holiday, to give attention to individual tastes and idiosyncrasies, so that the lover of natural scenery, the seeker for historical associations, and the lover of art may each go where he will find what he will enjoy the most. For the best use of a holiday some definite object may be combined with the general fundamental idea of rest; but there is a possibility of carrying this feature too far and making the excursion a season of work. This leads to the next rule, not to attempt too much. "Take it easy," should always be the motto. Long railway journeys and tedious excursions drawing upon the strength are good things to avoid. Age, physical condition, and previous training should always be regarded; change of life and surroundings should be sought, but mischief may result if the change is too violent; and whatever interferes with regularity of life and sleep should be indulged in only sparingly. Provided the traveler is a good sailor, few forms of holiday are so entirely unobjectionable as a sea voyage.

MINOR PARAGRAPHS.

According to Curator Duerden, of the Museum of the Jamaica Institute, as cited by Robert T. Hill in Science, a turn of the tide has come in the life of the mongoose in Jamaica. This animal was imported there to rid the island of rats. Having disposed of these, it turned upon the other small animals and nearly exterminated them. Consequently the ticks and chigoes, in the absence of the lizards and snakes which had eaten them, throve enormously, and became nearly as veritable pests as the rats had been. Within the past few years, however, the mongooses have seemed to decline in numbers, and, when caught, to be suffering from the attacks of ticks. Birds and snakes and lizards are becoming more numerous, poultry and domestic animals suffer less from depredations, numerous crocodile's eggs are found, bevies of quails are occasionally seen, and the rats are appearing again.

The researches of Alfred Goldsborough Mayer on the color and color-patterns of moths and butterflies have resulted in the demonstration of several results believed to be new to science, among which are the prevalence of a surprisingly large percentage of black in the great majority of the colors of *Lepidoptera*, the composite character of the colors as distinguished from simple colors, and the derivation of the pigments of the scales by various chemical processes from the blood, or hæmolymph, of the pupa. While the number of species of *Papilio* in South America is nine times as great as in North America, the number of colors which they display is only twice as great. Hence the greater number of colors displayed by the tropical forms may be due simply to the far greater number of species, and not to any direct influence of climate. The scales in *Lepidoptera* do not strengthen the wing or aid the insects in flight. The vast majority of the scales are merely color-bearing organs which have been developed under the influence of natural selection.

According to a communication of M. Albert Gauttard to the French Ethnographic Society, the efforts which the Japanese have been making since the revolution of 1868 to adapt themselves to European civilization and modes of life have resulted in surprising transformations of their national type. Some of them are losing the eccentricity of their eyes and the prominence of their cheek bones; children born recently have less flattened noses than their ancestors, and a skin not so yellow. On the other hand, Europeans residing permanently in Japan lose the rosy color of their skin and tend to acquire an eccentricity in the eye. M. Adhemar Leclère, French resident at Kratié, said that he had observed that some of the French residing in Cambodia began in a short time to acquire the type and the gait of the natives.

In the use of the Iroquois wampum belts, his studies of which have already been noticed in the Monthly, the facts associated, and other features in the Indian life of both American continents, Mr. Horatio Hale believed that evidence was found that the Indians enjoyed systems of government and forms of civilization that evinced intellectual and moral faculties of no mean order—a real money, elements of a written language

widely diffused and employed in preserving the memory of treaties of peace and alliance, established institutions working well, and a good degree of generally diffused comfort.

NOTES.

THE summer courses of the Massachusetts Institute of Technology, beginning at different dates in June and generally continuing through July, are intended for the benefit of students who wish to prolong their stay in summer or to make up deficiencies, and are open to persons not students in the institute if they possess the necessary qualifications. The subjects are in the departments of mechanical drawing and descriptive geometry, mathematics, architecture, chemistry, biology, physics, European history, French and German, mechanism, and shop work; and provision is made for other (non-technical) subjects for those interested in them.

THE International Exposition to be held at Brussels this year will include an International Section of Sciences, divided into the seven Sections of Mathematics and Astronomy, Physics, Chemistry, Geology and Geography, Biology, Anthropology, and Bibliography. Various privileges will be granted to participants, who will have to pay nothing for their places, and will be allowed rebates on railroads. A series of questions have been prepared by the Belgian Government, on which prizes will be awarded for the best solutions. The prizes appertaining to the Section of Sciences are valued at four thousand dollars. Programmes contain full information on this subject by addressing the Commissariat General of the Government, 17 rue de la Purse, Brussels.

THE Division of Entomology of the United States Department of Agriculture is engaged in a special investigation of the insects that infest stored crops. The list includes the insect enemies of stored grain, flour and meal, fruits, nuts and seeds, herbs and dried plants, drugs, leather, specimens of natural history, etc. Information is invited from citizens who have made observations in the matter, particularly from persons residing in the South. Special attention is directed to the use of bisulphide of carbon, applied as a vapor to pervade the stored material.

GRANITE, wood, and asphalt being accepted as the best materials for carriage-way pavements in large cities, preference between them should be, Mr. L. H. Isaacs, C. E., says, in the order, on the score of public hygiene: asphalt absolutely, granite, wood; of noiselessness, wood, asphalt, granite; of safety to horses, wood, asphalt, granite; of cleaning, asphalt, wood, granite; of economy, granite, wood, asphalt; of facility in repairing, asphalt, wood, granite; and of convenience in connection with tramway rails, granite, wood, asphalt.

ALVAN H. CLARK, the famous maker of telescopic lenses, died of apoplexy at his home in Cambridge, Mass., June 9th. He succeeded his father, Alvan Clark, whose fame as a lens maker was equally world-wide, as head of the firm on the death of the latter in 1887. Of his make were the twenty-six-inch lens in the Naval Observatory at Washington, and the thirty-inch refractor for the Imperial Observatory at St. Petersburg, for which he was decorated by the Czar; the great lens of the Lick Observatory; and the lens for the Yerkes Observatory, Chicago, forty inches in diameter, and having a focal length of sixty-four feet, which was completed and shipped only a short time before his death. As an astronomer he accompanied the total-eclipse expedition to Jerez, Spain, in 1870, and the similar expedition to Wyoming in 1878; and discovered fourteen double stars, including the companion to Sirius—for which he received the Leland gold medal from the French Academy of Sciences.

DR. TRAILL GREEN, Emeritus Professor of Chemistry in Lafayette College, died at Easton, Pa., April 29th, aged eighty-four years. He became a professor in Lafayette College sixty years ago; was dean of its scientific department and founder of its astronomical observatory; was one of the original members of the American Association; was first President of the American Academy of Medicine; and was author of a work on the Floral and Zoölogical Distribution of the United States.

MR. J. THEODORE BENT, explorer, classicist, and archæologist, died in London, May 5th, of malarial fever contracted in a journey in Sokotra and southern Arabia—from which he had just returned with Mrs. Bent—followed by pneumonia. He had spent the winters of several years in journeys of research, the fruits of which he recorded in valuable and interesting books. Among the subjects that engaged his attention were the archæology, classic survivals, and customs of Greece; the Bahrein Islands of the Persian Gulf; the Arabian states; Abyssinia; and Mashonaland, where he was the first to make a systematic exploration of the ruins of Zimbabwe. His papers before the Royal Geographical Society, the British Association, etc., were of high merit, and his collections had unique value.

THE Duc d'Aumale, who died from the effects of the shock occasioned by the terrible disaster at the Charity Bazaar in Paris, was a member of the French Academy, and was distinguished throughout the scientific world for his gift to the Institute of France, in trust for the nation, in 1884, of the Château of Chantilly for a museum, with the forest and estates for its maintenance.